# AMATEUR WORK

A MONTHLY MAGAZINE OF THE USEFUL ARTS AND SCIENCES

Vol. III. No. 3. BOSTON, JANUARY, 1904. One Dollar a Year.

## A MAGIC LANTERN

### For the Home or Small Halls.

As a means of pleasant and interesting entertainment, a well made magic lantern possesses many attractions to the amateur, and this is especially true if several friends also have lanterns, the exchanging of slides serving to give sufficient variety to sustain interest through many evenings. In addition, the multitude of slides which may be hired or purchased, open up a wide field, limited only by the capacity of one's pocket book or inclinations.

The lantern here described, while made for home use, requires no change, other than the objective, to adapt it for large halls, and two of them with a dissolving attachment would equal in worth that of an expensive lantern. The sizes of the condenser and objective as given in this lantern can be charged, if necessary, to other approximate sizes, and the reader is advised to purchase these before constructing the lantern, that he may know their exact dimensions and work accordingly. These sizes specified were purchased of a dealer over stocked on these sizes and because of a substantial reduction from regu lar prices. Readers in large cities are advised to visit the different optical and photographic supply houses, as by so doing they may be equally fortunate in securing a bargain. For house use, a wide angle or small lens is necessary, as the size of the picture thrown on the screen depends upon the size of lens and distance between lens and screen as shown in the following table, giving the various sizes of pictures to be had with different objectives at varying distances from the screen when three-inch slide is used.

| Sizes of Lenses | Distance from Screen. 10 ft. | 20 ft. | 30 ft. | 40 ft. | 50 ft. | 60 ft. |
|---|---|---|---|---|---|---|
| Wide Angle | 6 2-3 | 13 1-3 | | | | |
| 1 5-8 inches | 5 | 10 | 15 | 20 | | |
| 1 7-8 ,, | 4 | 8 | 12 | 16 | 20 | 24 |
| 2 1-4 ,, | | 6 | 9 | 12 | 15 | 18 |
| 2 1-2 ,, | | | 7 1-2 | 10 | 12 1-2 | 15 |
| 3 ,, | | | 6 | 8 | 10 | 12 |

The several parts of the lantern include the objective or lens, and holder for same, focusing tube, slide box and frame, condenser and holder, burner and hood and adjustable framework, which will be separately described. The frame is made almost entirely of brass castings and tubing, the patterns for the castings being easily made from pine.

The shape and dimensions of the objective support are shown in Fig. 1. The casting *A* is finished with a file and fine emery cloth. The holes *a* are $\frac{1}{4}$″ diameter, pieces of 22 guage tubing 8″ long, being secured therein at one end by soldering. The guides *C* are made from a piece of $\frac{5}{8}$″ square brass tubing 5″ long, which has been split centrally, the lower ends being double rivited to the casting *A*. The slots *b*, 3″ x $\frac{3}{16}$″ are worked out with a small flat file, after drilling holes at each end with a hand drill and sawing down with a hack or heavy fret saw. The objective has a threaded flange which is mounted centrally upon the block *D*, Fig. 2, made of mahogany and nicely polished. It is 5″ square

and $\frac{3}{4}''$ thick, the sides fitting into the guides *C*, being cut down with a rabbet plane to an easy fit. At the centre of these sides, brass pieces *d*, 2″ long, $\frac{5}{8}''$ wide and $\frac{3}{16}''$ thick are let in, after drilling and tapping holes in the centre for $\frac{3}{16}''$ knurled head brass set screws. These are needed to adjust the lens to the correct position to throw the picture evenly on the screen.

The usually focussing arrangement of a lantern is a bellows much like those used in cameras, but this requiring considerable time to make and the use of materials not easily obtained, a telescopic tube was used, this being made from a one pound coffee tin for the outer tube and the inner one from a re-soldered tomato can. The latter was heated along the seams over a furnace fire until they separated, then cleaned and re-soldered to an easy sliding fit to the other can. This gives ample adjustment. The condenser cell was made in the same way, with the exception that the case of an old alarm clock was used for one section, and a coffee tin for the other, the length of each having to be cut down to the dimensions given later. The ends of the cans were cut out to give a flange about $\frac{1}{8}''$ wide. First mark with dividers, if an old pair is available, sharpen one point and use to cut through by continued working around the line. With a lathe, mount on face plate with wood backing and cut with hand tool. A coat of black enamel paint will give a good finish. One tube is attached to the piece *D* by four short round head screws, the heads of which lap over the flange, the location being marked by striking a circle with dividers after the frame is completed so that the parts will not bind anywhere. The other tube is riveted to the slide holder support *S*, Fig. 3. Suitable rivets are made by cutting off the ends of brass escutcheon pins, filing the ends smooth. The heads are on the inside of the tube, held during riveting against the top end of a cold chisel or piece of bar iron held in a vise.

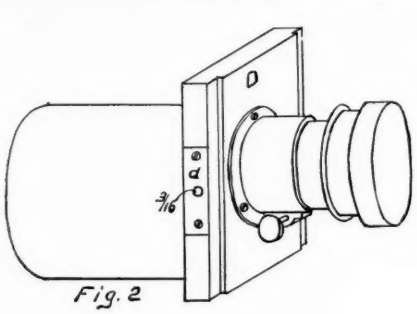
The slide holder support is made of a strip of sheet aluminum, 16 guage or thereabouts, 14 $\frac{1}{4}''$ x 6″. The faces are 6″ square, the ends $\frac{7}{8}''$ and the lap for the joint $\frac{1}{2}''$. The turns are marked with a scratch point then bent carefully to shape. If convenient, take to a tin shop and have the bending done on a machine. The circular openings in each face are cut out before bending. This can also be done at the tin shops at little or no expense, and a better job secured than ordinarily if done by the reader. The size of the holes cannot be determined exactly until the condenser cell is completed, so this part should be left until after making the condenser. A piece of $\frac{9}{16}''$ tubing *S′*, 4″ long is attached to each lower rear corner of the holder, by first sweating on strips of brass *S″*, the ends of which are turned outward to form lugs for riveting to the holder, as owing to the nature of aluminum, they cannot be soldered to it. The final length of these pieces is found when the frame is completed, they are then cut off to bring the rear hole in the holder in line with the condenser.

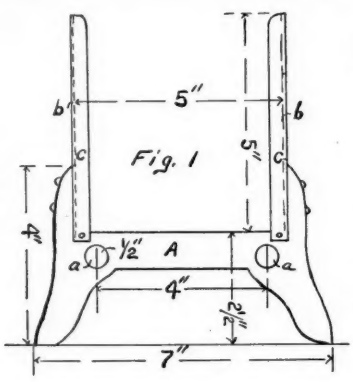
The remaining part of the frame is now to be made. Three brass castings *F*, *F′*, *F″* Figs. 4 and 6, are required. These are finished by filing and with fine emery cloth. Holes are then drilled for the $\frac{9}{16}''$ brass tubing *G*, 22 guage which must be in exact line with the tubes in the holes in *A*, as these tubes slide within each other. The rods *G* are 5″ long, and are sweated into the holes drilled in *F* and *F′*. Other $\frac{9}{16}''$ holes are then drilled in all these pieces *F* for the rods *G′* which are 12″ long. These are sweated in, but care should be taken to have the brass casting *H*, Fig. 6, finished, fitted and in place before this is done. This casting has $\frac{9}{16}''$ holes drilled in line with the tubes *G′* and slides freely thereon. Two pieces of $\frac{1}{2}''$ brass tubing *h*, 4″ long, are fitted to holes drilled in *H* and spaced to fit the pieces of $\frac{9}{16}''$ tube *S′* on the slide frame holder. Knurled head set screws *j* are fitted to each end of *H* and also to *F* as shown at *f* Fig. 5, for fastening the rods *B*.

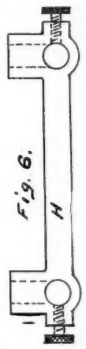
The condenser cell is made as previously mentioned for the focussing tube. The size is regulated by that of the condensing, lenses plano-convex lenses 4 $\frac{1}{8}''$ diameter being used in this lantern, as the same were obtained from an over stocked dealer at a very low price. The usual sizes vary from 4 $\frac{1}{8}''$ to 4 $\frac{1}{2}''$ diameter, the smaller ones being quite as good for this lantern as the larger, and the reader will find it to his advantage to look up the lenses, and see what may be obtainable at less than usual prices. The convex faces of the lens are together with only about $\frac{1}{8}''$

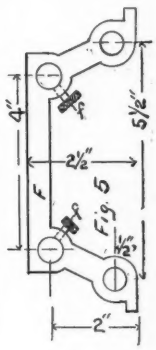
to $\frac{1}{4}$" space between. The tubes are 1 $\frac{3}{4}$" long, with narrow flanges not over $\frac{1}{8}$" wide on the outside. The lenses are kept in position by punching V shaped lugs in three or four places, the points being bent inward after the lenses are in place.

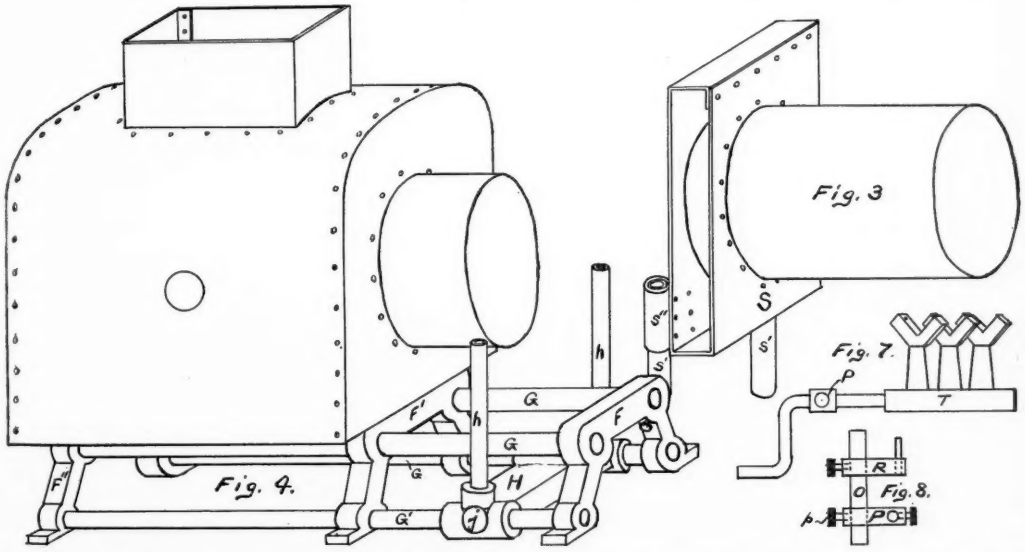
The body of the lantern is made of sheet aluminum, about 24 guage, this metal having properties which peculiarly adapt it for that purpose; it radiates heat so rapidly that the hot flame of the burners does not heat it to near the extent it would brass or Russian iron. The sheet size is 6 ft. long, 12" wide, a piece this size 24 guage, weighing about 1 $\frac{3}{4}$" pounds and sold at about 75 cents per pound. As it cannot well be soldered, joints are made by riveting, the rivets being made from brass escutcheon pins, as previously mentioned, the heads inside. But little of the rivet should project for heading up. The shape of the body is practically that of a box 8" long, 7" high and 7" wide, the top being curved as shown. One strip is used for the sides, top and bottom, a piece 28" long and 8" wide being required, the lap joint being made at one of the lower corners. Ten $\frac{1}{2}$" holes are punched in the bottom for admitting air.




The front or condenser end has a $\frac{1}{2}$" flange all around fitting inside for riveting, and a hole in the centre about 4 $\frac{1}{4}$" diameter, to which is riveted a flange 1" wide for holding the condenser cell. This flange, also made of aluminum, has lugs all around the inner edge for riveting to the end. The rear end has a large door with hinge on the right side, made by bending over lugs left on the door, and also the piece cut out for same.

Smaller lugs are left on the left side for bending over to hold a piece of wire with an eye end for fastening. A hole 4″ long and 2 wide is cut in the centre of the top. A 2″ flange is then fitted to this hole by riveting. A chimney 8″ high is fitted to the outside of this flange; a monitor top is fitted to the chimney. The chimney is not fastened, as it is removed when not in use to reduce the space required for packing away. The body is fastened to the castings *F″* and *F‴* by four round head machine screws, holes being drilled and tapped for same.

The burner is made as follows: — To the centre of a piece of ½″ square brass tubing *T*, Fig. 7, 4″ long is soldered three acelylene burners, after drilling ¼″ holes for admitting the gas from tube to burners. The outer end of the tube is then closed by turning down a section of the top or burner side, after cutting away with a hack saw the other three sides. This is done to prevent having a soldered joint of the upper or hotter side. The joint is well sealed with hard solder, and should be a good job to avoid leaking. If the reader does not feel equal to doing this have it done by a plumber, as it will cost but little. The other end is then closed in the same way, making the finished tube 3″ long, and a piece of ¼″ brass tube 6″ long, fitted thereto by sweating after drilling a hole to admit the end of same. The arms of the burners are at an angle of 45° with the tube.

The burner and reflector holder consists of a piece of ½″ brass tubing *O*, Fig. 8, 3″ long fitted to a hole drilled in the top of the casting *F‴* about 1″ to the left of the centre. The exact position is found after the burner and holder are completed, the object being to bring burner and reflector exactly in line with the centre of the condenser. A piece of brass rod *P* 1 ½″ x ¾″ x ⅝″ is drilled at one end for the tube *O*, and fitted with a set screw *p*. A ¼″ hole is drilled at the other end for the tube of the burner, and a set screw fitted at that end. The reflector holder *R* is a piece of brass rod 2″ x ¾″ x ⅝″ drilled at one end for the tube *O*, and fitted with a set screw. At the other end a piece of ⅛″ round brass rod is fitted to a vertical hole, and also fits a hole to be found on the back of metal reflectors. One about 4″ diameters is a good size. A piece may have to be cut out at the bottom to fit around the burner tube. The burner tube after being put through the holder *P* is bent downward and carried through a hole in the back end of the body. A ¼″ lever handle air cock is then soldered to the end, and the rubber tubing from the generator pushed well into the end of the cock. This method of fitting burner and reflector enables accurate adjustment to be made, a very important feature as will be learned when using the lantern. A 1″ hole is cut on either side of the lantern at about the centre, and fitted with pieces of ruby glass, giving a chance to view the flame while using the lantern and without opening the door.

The lantern is now complete with the exception of the slide holder, which together with the acetylene generator, slides and coloring of same, will be described in subsequent numbers of this magazine.

NOTE: — The castings, tubing and other parts necessary to make this lantern will be offered as a premium should a sufficient number of readers make request to have this done.

---

A comparison of gasoline and alcohol with regard to their relative heating value is possible after recent Austrian experiments. For motive purposes a pair of nominal 8 H. P. engines, one designed for alcohol and the other for gasoline, were compared. The gasoline had a specific gravity of 0.7 and a calorific value of 7,700 calories per litre; the consumption per horse-power was 340 grammes. The denatured alcohol (methylated spirit) was of 90 per cent. strength, and had a calorific value of 4,900 calories per litre; its consumption was 373·5 grammes per horse power. The efficiencies were, therefore, 16.5 per cent. for the gasoline, and 28 per cent. for the alcohol.

---

Thomas A Edison, the inventor, is credited with having perfected a new electrical generator which will revolutionise the methods of producing electricity. The generator derives its power from a new kind of fuel; which Mr. Edison is keeping secret. Three pounds of it is said to be sufficient to secure enough electricity to light a house or run an automobile for a day.

# MICROSCOPY FOR AMATEURS.

S. E. Dowdy. M. P. S.

## III. OBJECTIVES AND EYE-PIECES.

It now only remains to describe the objectives and eyepieces. Microscope lenses, objectives, or powers as they are variously termed, consist of combinations of lenses of varying magnifying power, mounted in short brass tubes furnished with a standard size screw for attaching to the lower end of the microscope body-tube. The gauge recommended by the Royal Microscopical Society is the one almost universally adopted by makers nowadays, and in no case should an instrument be obtained having any other gauge for its lenses.

There is little fear of getting such an instrument new; but some of the older makers might differ in this respect. To distinguish them from one another and indirectly to indicate their magnifying power, English lenses are designated in inches and parts of an inch, Continental ones by millimetres. For instance; an English lens might be a $\frac{1}{2}''$, $\frac{1}{4}''$, and so on, down to $\frac{1}{40}''$ or $\frac{1}{50}$ of an inch, whereas a lens by a German maker might be a 24, 12, or 6 millimetre, as the case might be.

The beginner is naturally apt to fall into the error that, because a lens is called, say a 1″, that it will focus at exactly that distance from an object. This is not necessarily the case, the terms applying to the focus of a single lens of the same magnifying power. The objective may be an optical combination of half a dozen lenses, the front one of which may and probably does focus much nearer to the object than the objective's designation would imply.

The value and cost of an objective is partly dependent upon its magnifying power, but more so upon what is termed its numerical or angular aperture. It is difficult to explain the meaning of this term in a word or two, but briefly it refers to the angle at which the rays of light from an object can enter the objective to form a well corrected image. This is not dependent on the size of the front lens of the objective, as a beginner might expect, but is a question of the curvature of the various lenses making up the combination. A lens of wide aperture, providing the proper corrections have been made in it, will admit more light and show more detail than a narrow apertured lens of the same magnifying power. It is therefore superior to the latter, but owing to increased skill and work required for its manufacure, is much more expensive. Students' lenses are now made with larger numerical apertures than they used to be, owing to a more general recognition of the fact that on the aperture depends the resolving power and definition of the lens, providing workmanship is good. The bearing that aperture has on the performance of a lens will be noted, when we come to the testing of lenses, as it is rather an important point. We now come to the *eyepieces.*

Those that the student will require are what are known as Huyghenian, consisting of a couple of plano-convex lenses mounted in a short metal tube. The lower lens is termed the field lens, the upper the eye lens. Eyepieces are constructed of various magnifying powers from about 4 diameters up to 18 or 20. Low power eyepieces, which are the most useful, are sometimes called shallow, those of higher power, deep eyepieces. A student's stand is generally supplied with one low-power eye piece, magnifying four or five diameters, but an extra one of rather high power is well worth obtaining, as they can be obtained for $5 each.

It is of little use for the beginner to buy an eye piece of higher power than one magnifying about ten diameters, for the following reason :— In observing an object with a compound microscope, the image formed by the objective is further magnified by the eyepiece. Any imperfections, therefore, in this primary image are accentuated by the eyepiece in proportion to its magnifying power. Carefully corrected lenses of wide aperture will stand deep eyepiecing without appreciable deterioration of the image; but students

lenses, though giving excellent results with low power eyepieces, break down under high power ones. This is the reason why, in testing microscope lenses, the appearance of the image is noted under a deep eyepiece.

We have now briefly enumerated the leading features of a student's microscope, and the novice is advised to make himself acquainted with the specific purpose of each part of his instrument before proceeding to do work with it. Each observer has different methods of working, but it is he who has the better knowledge of the capabilities of his microscope who will make the best microscopist.

The next thing after, or better still, the first thing before purchasing a microscope is to test its objectives, eyepieces, and adjustments. Take nothing for granted, but carefully see that each adjustment is efficient, and above all things, that the lenses are of good quality. For actual working, daylight, for several reasons is preferable; but for testing lenses, artificial illumination admits of more control, and will serve our purpose better. For providing the necesaary light a small kerosene lamp will be required, any hand lamp with a $\frac{1}{2}''$ wick will do. The microscope should be placed on a steady table or bench, with the lamp on the left-hand side, and slightly in advance of the instrument. The probability is, if the microscope has been purchased complete, that it will possess a couple of objectives, a $1''$ or $\frac{2}{3}''$ and a higher power of from 50 to 500 diameter may be obtained.

We will now start with the low-power lens, as it is easier to use. Screw it into the lower end of the body-tube, and place the low-power eyepiece in the upper end of the tube. Now manipulate the mirror so that a beam of light is thrown up through the stage aperture into the field of the lens. On looking through the eyepiece, a brilliant circle of light should be seen, this being called the field. If unevenly illuminated, a fresh adjustment of the mirror, or a slight alteration in the position of the lamp will be necessary. If the microscope is fitted with an Abbe substage condenser, the top lens of condenser should be first removed before adjusting the light. It is, however, with the higher powers that the substage condenser comes in useful, so that a few words will be said with regard to the method of using it when we are testing the high power lens. Now remove the eyepiece and look down the tube of the microscope, and see how much light is entering the objective. If full of light, rotate the diaphragm under the stage until the cone of light from the mirror is cut down until it illuminates about two-thirds of the back lens of the objective; then replace the eyepiece. We shall now require a test object, which is one possessing fine enough markings or detail to require a good lens to show them well. Most opticians supply suitable objects already mounted, such as the tongue of the blow-fly, for low powers, and diatoms and insect scales for high power lenses. As recourse to an optician is not always available, we will select an object readily obtainable, at least, during a good part of the year, easily mounted, and furnishing a good test of the capabilities of a lens. I am referring to the wing of the common house fly. After killing the insect, detach one of the wings and place it on a thin $3'' \times 1''$ glass slide, cover it with a thin square cover glass, which should be held down by a couple of strips of postage stamp paper.

The object is now ready for examination, the slide can therefore be placed on the microscope stage, with the object in the centre of stage apature. Now use the coarse adjustment by either sliding the body tube up or down or lightly rotating the milled heads provided for the purpose. When the image is coming to a focus, note the working of the coarse adjustment. A good rack-and-pinion adjustment should give a smooth, gliding motion free from jerks, and on looking at the object no displacement to one side should be noticed on altering the focus. When a sharp focus has been obtained, carefully note the appearance of the object, which will present the appearance of a delicate membrane studded with minute hairs and traversed with thickenings of the membrane, which thus form a framework. A fringe of very fine hairs will be found edging the wing, and particular attention should be directed to these. With a good lens each hair will stand out perfectly sharp and clear, with no trace of a colored fringe surrounding it, and the hairs on one side of the field of view will be in as sharp focus as those on the opposite side. Now pull out the draw tube, if the microscope is fitted with one, and re-focus. Increased magnification

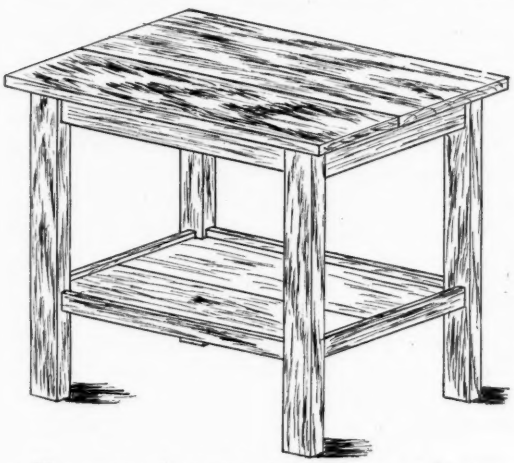
is the result, but the defination will probably fall off a bit, partly due to the lens probably being corrected for a short tube length. Push in the draw tube and substitute the high power eyepiece, and note the effect. A less brilliant image will be the first noticeable alteration, also, of course, an enlargement of the image. No further detail will be shown, but we have now to note what appearance this enlarged detail presents. If the hairs on the edge of the wing still present a perfectly clear, sharp cut outline, and are free from color, the lens may be relied on for any work the student is likely to require it for.

*Euglish Mechanic.*

# A SMALL TABLE.

JOHN F. ADAMS.

This small table was made to use up some odd pieces of wood, but has proved so very convenient that a description is here given. The top is 22″ x 32″ x $\frac{7}{8}$″, glued up from two pieces of whitewood. The legs are 30″ x 2 $\frac{3}{4}$″ x 1 $\frac{3}{4}$″, spruce joist in this case, planed up smooth. The larger pieces under the top are 26″ x 3″ x $\frac{7}{8}$″, the shorter one 14 $\frac{1}{2}$″ x 3″ x $\frac{7}{8}$″. This allows $\frac{3}{4}$″ on each end for tenons to fit mortises cut in the tops of the legs, spaced so as to bring the outer edges $\frac{3}{8}$″ from the outer sides of the legs. The mortises were made full size of the cross pieces, but a better way is to cut tenons with a $\frac{3}{16}$″ shoulder, and mortises to match, the table then being more rigid.



The cross pieces for the shelf are of the same lengths as those above but are 2″ wide, mortises being cut in the legs so as to bring the under side of these pieces 9″ from the floor. The joints were glued, and pinned with dowels made from meat skewers. It may be well to state that gluing in cold weather should be done in a warm room, the stock to be glued having been warmed to at least the temperature of the room.

The shelf is also glued up, and when thoroughly dry cut to fit around the legs, then nailed through the cross pieces. The top is attached to the upper cross pieces by eight screws, $\frac{1}{2}$″ holes being bored to a depth of 2″ and screw holes the rest of the way. These holes should be bored before finally setting up the table, as there is hardly room for a bit stock and bit between the cross pieces when put together.

After sand-papering, weathered oak stain was applied, this dark stain being particularly suitable for such a table. It was thinned out a little with spirits to bring out the grain a little, the woods used having but little markings. A coat of thin varnish completed the finish.

---

The Edison commercial phonograph is said to have been so far perfected that it is practicable for taking court testimony and for constant employment in the office, one record being capable of taking several dictated letters. It can be shaved 175 times, making it as cheap as letter paper.

---

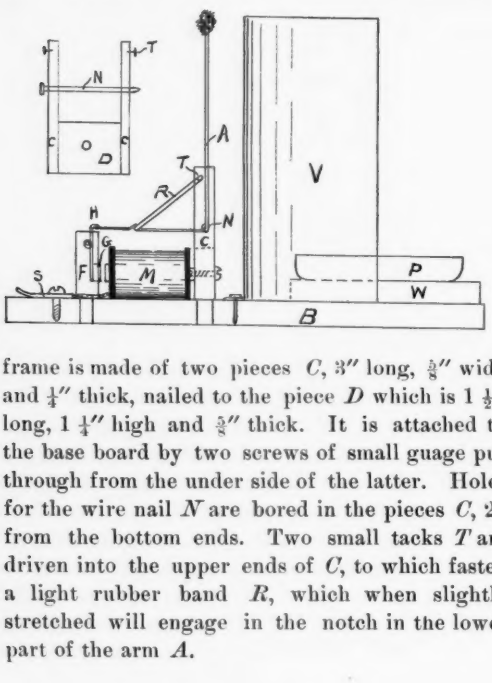
In a paper read before the German Physical Society, Mr. H. Starke describes experiments on cathode rays, which confirm the idea that the apparent mass of the flying corpuscles is purely electrical.

# PHOTOGRAPHY.

## AN ELECTRICALLY OPERATED FLASH-LAMP.

The particular advantages of this flash lamp are; — It may be operated from any location, and at any time desired by the operator without others having previous notice of when the lamp will flash. It is thus possible for the operator to be included in a group, and the peculiar contraction of the eyes so characteristic of most flash-light pictures is avoided, as any oppertune moment can be utilized for the flash.

The novel feature of this lamp is the use of an electric magnet for releasing the trigger, the latter working much after the fashion of a mouse trap. The horseshoe magnet *M* can be taken from an electric bell. It is mounted upon a wooden base *B* which measures 12″ long, 5″ wide and ¾″ thick. A hole will be found in the centre of the bar connecting the two coils of the magnet. Through this hole put a small screw attracting the magnet to the frame holding the arm *A*. This




frame is made of two pieces *C*, 3″ long, ⅝″ wide and ¼″ thick, nailed to the piece *D* which is 1 ½″ long, 1 ¼″ high and ⅜″ thick. It is attached to the base board by two screws of small guage put through from the under side of the latter. Holes for the wire nail *N* are bored in the pieces *C*, 2″ from the bottom ends. Two small tacks *T* are driven into the upper ends of *C*, to which fasten a light rubber band *R*, which when slightly stretched will engage in the notch in the lower part of the arm *A*.

The brass or iron wire arm *A* is 2 ¾″ long on the horizontal section, and 4 ¾″ long on the vertical. In cutting, also allow for two turns to go around the nail *N* with a loose fit, and a turn at the upper end to hold a tuft of asbestos wool or cotton wicking. The end at the triger is hammered out flat and then filed smooth, but no bevel on the top side. A notch for the rubber band is bent in the centre of the horizontal part as shown.

The trigger is made of the armature *G* of soft iron, also taken from the electric bell. The hammer of the bell is an extension of this armature. The surplus pieces are removed as only the armature is needed. A piece of iron wire *H* is fitted to a hole drilled in the centre; two turns are made ⅝″ above the armature to fit around a nail shaft as before described, and ⅛″ of the upper end is bent at right angles, ⅝″ above the centre turns. Two supports *F* are 2 ½″ high, ⅝″ wide and ¼″ thick, ¾″ of the lower ends being cut down to fit ¼″ holes in the base bored to receive them. Holes are bored in these supports 1 ⅜″ above the base for the nail *O*, but this should not be done until all the parts described are in position so that the trigger may be located in just the right place. The two wires from the magnet are each carried to connecting springs *S* made of short pieces of spring brass, a hole being bored in one end to receive a round head brass screw under the head of which is carried a wire from the magnet. The ends of other wires connecting battery and push button can be readily placed under the ends of these springs when connecting up for the work.

The powder pan *P* is made of tin, (that taken from an old preserve can will serve) and is 8″ long, 3″ wide and ¼″ deep. It is attached to a block of wood *W* ½″ thick, by a round head screw located on one side so that it may be turned to be in line with the base board when not in use. The block *W* is curved on the rear side to an arc fitting the reflector *V*. The reflector is made from a bright piece of tin from a fresh preserve

can, and is 6″ high, and 8″ long. On the lower edge three lugs ½″ wide and long are left, one in the centre and one near each end, which are turned toward the front and are pushed between the block *W* and the base, holding the reflector upright when in use and yet allowing easy removal for packing up. At the centre of the reflector a slot ½″ wide is cut from the top nearly to the bottom, for the arm *A* to drop through.

To operate, the terminals *S* are connected by flexible wire to battery and push button as follows; run a wire from one terminal *S* to zinc of a dry cell; from the carbon of cell run wire to push button; from the other terminal *S* run wire to push button. Put the flash power on the tray *P* spreading it along in a line so it will not all fire at once, but make a running flash. The tuft of asbestos on the arm *A* being wet with alcohol, the trigger is set and the alcohol lighted. By pressing on the push button, the circuit will be completed, the magnet will attract the armature *G*, releasing the arm, the rubber band will pull the arm over so that the weight of the upper part will cause it to continue falling until it reaches the powder and flashes it.

The length of the connecting wires is as may be desired by the operator. If one dry cell does not furnish sufficient current to attract the armature use two. A few trials without powder will enable any needed adjustments to be made.

# A MODEL STEAM TURBINE.

W. HALCOT HINGSTON.

The steam turbine, where used as the propelling machinery of a model steamer, has several distinct advantages over engines of the reciprocating type. When designing machinery for model steamers the chief difficulties are; — The small size of the engine room, the difficulty of making sufficiently powerful machinery light enough for the displacement, and the further difficulty of keeping the centre of gravity of the said machinery sufficiently low down to make the boat seaworthy. The steam turbine gets over all these difficulties, it being small, light for its power, and it can be put at the very bottom of the boat.

There are two types of steam turbine which have proved specially successful in actual practice (i. e., not model work) these being; — The De Laval (jet type), the Parsons (parallel flow,) In building a model, one or the other of these types may be used, but in a modified form; and as the Parsons turbine would make a very difficult and complicated model, a modified type of the De Laval turbine has therefore been chosen by the writer. Of course, a steam turbine can be used for many other purposes, but its advantages are more marked in model steamer work, and, therefore, I shall endeavor to explain how one can be constructed suitable for a boat about 5 ft. long, which seems to be the most favored size amongst model makers.

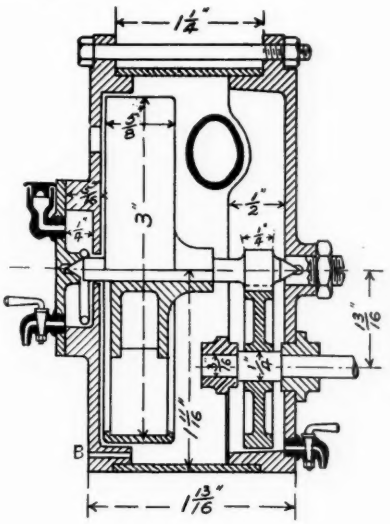



FIG. 2.

The De Laval turbine is an impact turbine, and consists essentially of a wheel carrying a number of suitably shaped vanes, on which steam

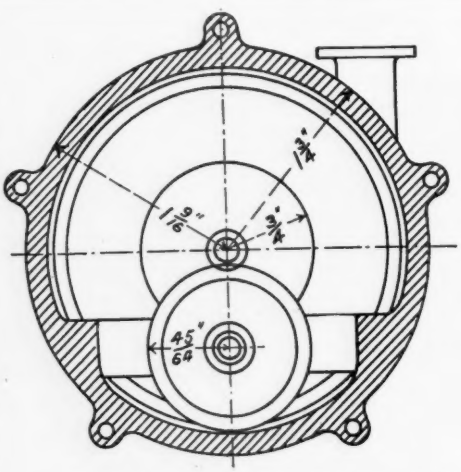



FIG. 2.—CROSS SECTION OF TURBINE.

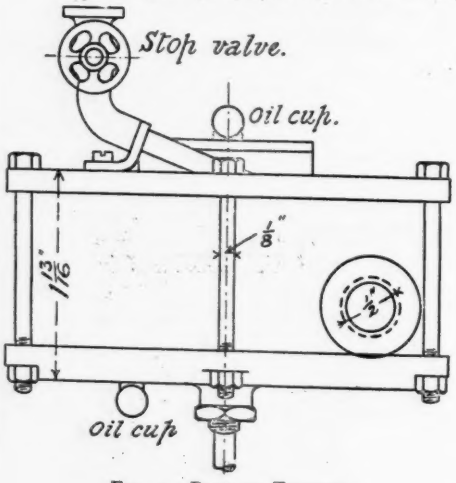



FIG. 3.—PLAN OF TURBINE.

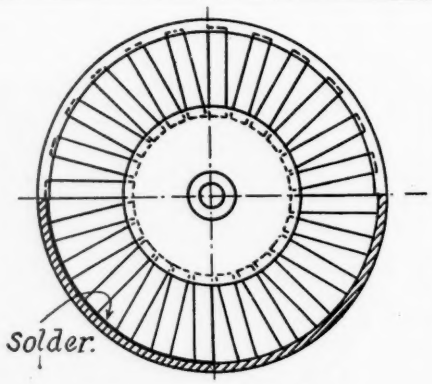



FIG. 4.—ELEVATION OF WHEEL.

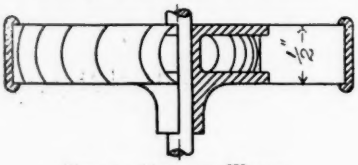
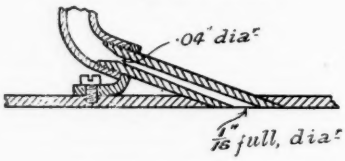



FIG. 5.—PLAN OF WHEEL.




DETAIL OF NOZZLE.

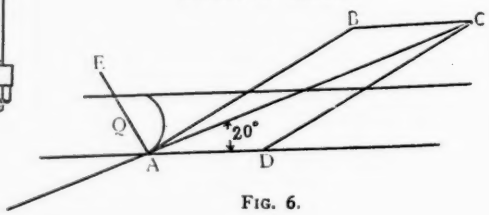



FIG. 6.

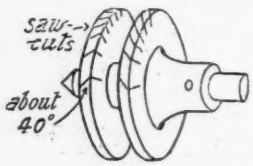



FIG. 7.—BOSS OF WHEEL.

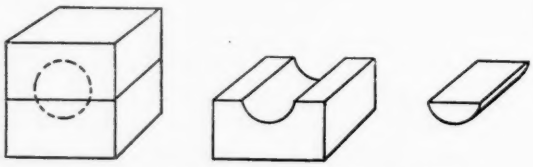
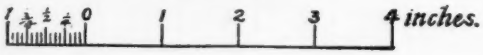


FIG. 8.—MOULDS FOR CURVING THE BLADES.




DETAILS OF MODEL STEAM TURBINE
(DE LAVAL TYPE.)
BY W. HALCOT HINGSTON.

impinges from one or more nozzles. As nothing definite is known about the power which a model turbine of any particular size will develop, the governing factor must be the amount of steam with which it can be supplied. A model steamer of about 5 ft. in length can easily be fitted with a boiler having from 100 to 150 sq. in. of heating surface. Assuming, therefore, that we have a boiler with 120 sq. in. heating surface, working at 30 lbs. per sq. in, about 1.2 cubic in. of water will be evaporated per minute, which will give 686.4 cubic in. of steam at 30 lbs. pressure.

The total jet area which the boiler will supply can approximately be found from Rankine's formula: —

$$w = \frac{6ap}{7}$$

$w$ = weight in lbs. of steam at absolute pressure
$a$ = area in square inches of jet
$b$ = absolute pressure of steam

$$a = \frac{7 \times 0431}{270} \quad \therefore \; a = 00112$$

But the co-efficient of discharge is .9, and therefore, the area required should be .0012. This gives a jet diameter of .04 in. The steam nozzle is made from a piece of brass rod, outside diameter $\frac{7}{32}$ inch. (bare). A hole .04 in. diameter is bored through the middle of it, and is tapered out as in sketch. The method of attachment of the nozzle is described later on.

The vane wheel of the turbine consists of a boss, round which a number of suitably shaped vanes are fixed. Outside these vanes is a brass band to keep the steam from escaping through centrifugal force. The dimensions and appearance of the wheel can be seen in Figs. 4 and 5. The boss (Fig. 7) is made of either brass or gunmetal, and can be built up or turned from a casting, the latter course being preferable. Its dimensions are: — Diameter of side plates, $1\frac{1}{2}''$, diameter of centre, $\frac{3}{8}''$, thickness of plates, $\frac{3}{32}''$, distance apart of plates, $\frac{5}{16}''$.

The centre of the boss extends on one side of the wheel, so that it can be fixed to the shaft by a pin driven right through. In the edges of the plates twenty-four equi-distant cuts are made with a fretsaw, into which the bottom edges of the vanes are sweated. These cuts are at an angle of about 40 degrees, with the side of the plate. The correct shape for the vanes has next to be determined.

Referring to Fig. 6, $A\ C$ represents the velocity of the steam (about 888 ft. per second) in magnitude and direction, the jet being at 20 degrees to the side of the wheels, and $A\ D$ equals the linear speed of the wheel, where the jet impinges upon it (about one-third velocity of the steam). Completing the parallelogram, $A\ B$ equals motion of the steam relative to the wheel. If the vane is then made so that $A\ B$ is tangent to it at one edge, the steam will glide on without shock, and can then be deflected by the vane. Draw from $A$, $A\ E$ at right angles to $A\ B$, then $Q$, the point where $A\ E$ cuts the centre line of the wheel, is the centre from which, with radius $Q\ A$, the section of the vane is drawn. This radius equals $\frac{9}{32}''$. The vanes are made from No. 28 B. W. G. brass, $\frac{3}{4}''$ long, and having the curve just found.

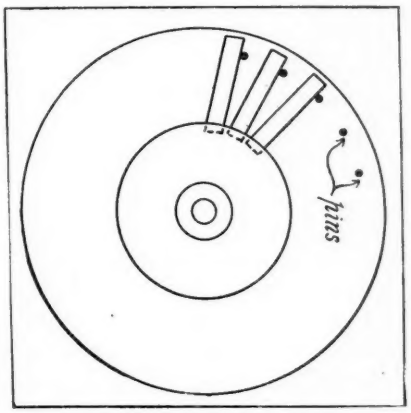



Fig. 9. Fixing Blades.

A simple device for making all the vanes identically the same can be made as follows: — Clamp two pieces of iron together (Fig. 8), and drill a $\frac{5}{8}''$ hole through them, whose centre is $\frac{1}{8}''$ from the joint, then on separating them, we shall have a mould slightly bigger than the vane. A piece of rod must now be turned up $\frac{9}{16}''$ in diameter, this must be filed away until it is just flush with the top of the mould, when a piece of 28 B. W. G. brass is between them. Twenty-four pieces of brass are then cut $\frac{3}{4}'' \times \frac{11}{16}''$, these must be carefully annealed and cleansed, they are then placed on the mould, and forced in by hammering the core on top of them. A few strokes with a file will remove the edges of the brass which protrude.

The boss, mounted on a mandrel, is now firmly fixed to a piece of wood with a hole 3 $\frac{1}{4}$″ in diameter by $\frac{5}{8}$″ deep, turned in it. A circle of ordinary pins must now be driven into the bottom of the hole at equal distances apart. The diameter of this circle should be about 2 $\frac{3}{4}$″ (Fig. 9). The vanes are now pushed into the saw cuts in the boss, the backs of their outer ends being against the pins. In this way the vanes are held in their places radially.

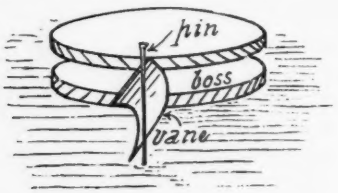



Fig. 9a. Sketch of Fixing Blades.

When all the vanes are in position, a thin mixture of plaster of Paris must be poured into the hole in the wood. When the plaster has thoroughly set, the boss and vanes, firmly imbedded in the plaster, can be taken from the board, the pins having been previously removed. It must then be mounted between centres, and carefully turned down to 2 $\frac{7}{8}$″ diameter. The outside ring for the wheel is made from a piece of solid drawn brass tubing, 3″ diameter and $\frac{1}{16}$″ wide, this must be thoroughly annealed, and one edge spun over, as in Fig. 4 and 5.

The plaster of Paris must now be carefully chipped away for a depth of about $\frac{1}{4}$″ from the ends of the vanes, and the brass ring slipped into place. A thin layer of solder is then sweated into the inside of this ring, which fixes the outer ends of the vanes firmly to it. The plaster is then chipped away from the other ends of the vanes, which are then sweated to the boss. The other edge of the brass ring must now be carefully spun over. When the remaining plaster of Paris is removed the wheel will be found to be perfectly true and strong.

The shaft is turned from a piece of steel $\frac{7}{16}$″ diameter, and has a disc left at one end in which teeth are cut for the necessary gearing. Its dimensions are:- length, 2″; diameter, $\frac{3}{16}$″; diameter of boss, $\frac{3}{8}$″; width of boss, $\frac{1}{4}$″. The ends of the shaft are pointed and hardened and run in two hollow centres. The boss of the wheel is bored a good fit on the shaft and is secured by a small pin driven right through it. The case of the turbine consists of two castings, Figs. 10 and 11, fitting into the ends of a piece of 3 $\frac{1}{2}$″ diameter, solid drawn brass or copper tube, the whole being held together by five bolts, as shown. These castings can be made in either brass or aluminum, preferably the latter.

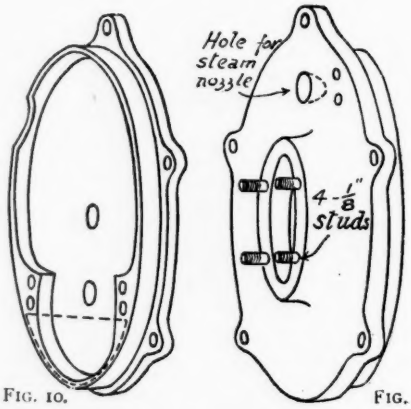



Fig. 10. Fig.

Ends of Turbine Casing.

Referring to Fig. 1, it will be seen that the left hand bearing for the shaft consists of a steel plate with a counter-sunk boss in the middle, which is attached to the end casting by four $\frac{1}{8}$″ studs, shown in Fig. 11. The boss must be deeply case-hardened for the end of the shaft to run in. The space between the steel plate and the end plate forms an oil chamber, the oil being conveyed to the bearing by a ring as in dynamos.

Fig. 13.
Oil Bath Casing.

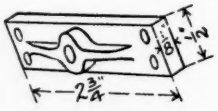


Fig. 12.
Bearing for Counter.

The right hand bearing is a $\frac{1}{4}$″ countersunk steel stud, screwed through a boss in the end plate, and held in position by a lock nut. This stud is also hardened. The pinion on the shaft gears into a gunmetal wheel 1 $\frac{3}{32}$″ diameter, mounted on a $\frac{3}{16}$″ shaft. This is supported on

the left by a gunmetal bearing (Fig. 12), screwed to bosses on the end plate.

A thin brass plate is soldered on the inside of the right hand end plate, as shown by dotted lines Fig. 10. This forms an oil bath in which the gear wheel runs, thus carrying oil to the pinion and bearing, and a thin brass cover should be put as in Fig. 13, to keep the oil from splashing all over the case. Oil cups and drain cocks can be fitted as shown to both oil baths. A small hole *B*, Fig. 1 is bored in the end plate to allow any condensed steam to drain from the case, and also in the end plate of the turbine case, and is reamed and filed until the steam nozzle fits in it at an angle of 20 degrees to the plate. The nozzle is held in place by a brass bracket sweated to it, which is fastened by two screws to the end plate. The joint between the nozzle and the end plate should be sweated with soft solder to make it steam tight. The exhaust steam passes through a $\frac{1}{2}''$ diameter tube soldered into the side of the casing.

Before putting the machine together, the vane-wheel should be run between centres and balanced as well as possible by scraping away pieces of solder from the rim of the wheel. When finally adjusting, the vane-wheel bearings should be left the least bit slack, so that the wheel may rotate about its centre of gravity. This is provided for in real De Laval turbines by having a long, flexible shaft, which, however, is impracticable in a model. The above slackness will not effect the gearing, as the steam will force the shaft against the right hand bearing, so that the pinion will remain practically central, any slight eccentricity occuring at the left hand bearing.

*Model Engineer, London.*

## FRUIT AND NUTS AS FOOD.

The United States Department of Agriculture has for several years been conducting a series of experiments to determine the dietary value of different foods.

Nine dietary studies and thirty-one digestion experiments were carried on. In the majority of the dietary studies, and all but one of the digestion experiments, fruit and nuts constituted all, or almost all, of the diet. The results of the investigation emphasise the fact that both fruit and nuts should be considered as true foods rather than food accessories. The subjects were two women, three children, two elderly men, and two university students. The men all did hard manual labor during a part of the time, the students working to support themselves while pursuing their studies.

The fare given in these experiments was in every case one that would appeal to any normal appetite. It embraced honey, tomatoes, apples, bananas, cantaloupe, grapes verdal, cornichon, tokay, muscat, scarlet haws, pears, pomegranates, persimmons, oranges, strawberries, watermelons, figs, almonds. and peanut butter. The only animal foods allowed were cottage cheese and eggs; and these in limited quantities. The cost of such a diet varied from 15 to 18 cents a day. Comparative experiments were carried along in which animal foods were employed under the usual conditions of living, and in these the daily cost ran from 26 to 30 cents. It was found that the food eaten supplied about 60 per cent. of the protein usually secured by the average meat diet, while health and strength continued the same, if not improved, and in two or three cases there was a slight gain in flesh and weight.

One of the chief objects of the series of experiments was to furnish data as to the value of nuts as food. Fruits contain little protein, and nuts are relied on in the fruitarian plan of eating to balance the ration. Fruits are rich in carbohydrates, and nuts in fat. A pound of peanuts, which costs 7 cents, furnishes 1,000 calories of energy at a cost of 3 $\frac{1}{2}$ cents, and protein at a cost of 36 cents per pound. A porterhouse steak costs for the same result respectively 22 $\frac{1}{2}$ cents and $1.31, when the steak can be bought for 25 cents per pound.

The average price per pound of the protein of nuts ranges higher than the corresponding average of meats; but the cost per pound of peanut protein is lower than for meats, fish, eggs, milk, diary produce, and prepared cereals. The only foods which furnish protein at a less cost than peanuts are flour and dried beans. According to Prof. Jaffa's experiments, nuts are the cheapest source of energy for the fruitarian, the peanut ranging far ahead of any other variety.

# AMATEUR WORK

77 WILBY ST., BOSTON

DRAPER PUBLISHING CO., PUBLISHERS.

A Monthly Magazine of the Useful Arts and Sciences. Published on the first of each month for the benefit and instruction of the amateur worker.

Subscription Rates for the United States, Canada and Mexico $1.00 per year. Single copies of any number in current volume, 10 cents.

TO ADVERTISERS.

New advertisements, or changes, intended for a particular issue, should reach the office on or before the 15th of the previous month.

Entered at the Post-office, Boston, as second-class mail matter Jan. 14, 1902.


## JANUARY, 1904.

The turning lathe mentioned in our advertising columns is a tool which the readers of this magazine will undoubtedly welcome with great enthusiasm. It is in no sense a toy, but a practical lathe, upon which good work may be done. Much time has been spent in its design and manufacture, for the sole purpose of securing a lathe satisfactory to the user, and what is of quite equal importance, at moderate cost. There is hardly one of our readers but can easily secure one of these lathes, by devoting a little time to obtaining subscriptions. A large number are being made as we know the demand will be large, and many will want them. Begin work at once and get the subscription of your friends before others have done so.

The first prize in our special premium offer, was awarded to Mr. F. L. Bain, of Cambridge, Mass., who receives the screw-cutting lathe. The winners of the others prizes will be announced in the next issue, several being so close in numbers that the result cannot be determined at the time our forms close. The ease with which some of our readers obtain valuable and useful tools, is ample evidence that others can do the same if they but decide to do it. Try it.

A number of letters have been received from readers relative to binding the numbers of volume II, with a binding uniform with that of the first volume. This matter is now receiving attention, and arrangements being perfected for binding, or supplying covers to enable the binding to be done at a local bindery. Particulars will be given in the next issue.

We are promised delivery on the reprint of volume I, and also the drafting scales at an early date, and same will be immediately sent those who have ordered them.

## HANDY RECEIPTS.

### BLACK INK.

The chemicals required to make one gallon of best black ink are:—

Nigrosine, "P." 1 ½ oz.

Methilyne Blue, 3° ¼ oz.

To one quart of water, either hot or cold, add the Nigrosine; stir well. To a small quantity of water, add the Methilyne Blue; stir well. Add both solutions together, mixing thoroughly; add enough water to make one gallon. The cost for the above quantity of chemicals is about 25 cents. This formula is in use in many schools throughout the country, and the ink gives excellent satisfaction.

### COLORLESS VARNISH.

Colorless varnish for use on fine labels or other prints, as well as for whitewood and other spotless articles, is made as follows:—Dissolve 2 ½ oz. of bleached shellac in one pint of rectified alchohol; to this add 5 oz. of animal boneblack, which should first be heated, and then boil the mixture for about five minutes, filter a small quantity of this through filtering paper and if not fully colorless add more boneblack and boil again. When this has been done, run the mixture through silk and through filtering paper. When cool, it is ready for use. It should be applied with care and uniformity.

### REVIVING WEAK DRY BATTERIES.

Old dry batteries, the current of which has become two weak for use, may be revived by punchihg several holes through the covering of hard pitch on the top, and allowing a solution of sal-ammoniac, or common salt and water, to soak into the cells.

Another way is to punch numerous holes in the sides, place them in glass preserve jars, filling the jars two thirds full of the solution. Considerable additional service may be obtained from cells thus treated, provided they are used where the liquid is not objectionable.

# TRANSFORMERS AND CHOKING COILS-

"M. I. E. E."

Fundamental Principles. — For purposes of transmission and distribution of electricity for lighting and power purposes on a large scale, high pressure currents are necessary from the economical point of view. As is well known, the adoption of alternating currents has, to a great extent solved the problem of economical distribution; but with alternating current, as with each system of distribution over long distances, arrangements must exist for converting somewhat feeble high tension currents into intense currents at low pressures. Such appliances capable of modifying in an inverse sense the two factors of electrical power, i. e., E. M. F. and current, are included under the general title of transformers. In fact, the claims upon which the superiority and adaptability of alternate currents are based depend upon the possibility of producing high pressures, and of transmitting them with limited loss, and more particularly also upon the facility and economy with which they may be changed from high pressures to low pressurers by means of converters.

It is with the intention of placing before our readers a brief outline of the theory, construction, and use of transformers and chocking coils that this short series of articles have been prepared.

An alternate current transformer, or simply a transformer, is a simple modification of an induction coil, used for converting small currents at high pressures into large currents at low pressures, and vice versa. It possesses three organs, two separate and distinct copper circuits, and an iron circuit. The iron circuit consists of a well laminated iron core, usually built up of thin, soft sheet-iron strips, so as to form a closed magnetic circuit. This magnetic circuit is interlinked with both of the copper circuits, one of which is supplied with electrical energy, and is known as the primary circuit, while the other becomes the seat of an induced pressure (when the primary current passes,) and is known as the secondary circuit. By varying the relative number of linkages, any desired transformation may be effected, and electrical energy in the form of a small current at a high pressure may be transformed into electrical energy in the form of a small current at a low pressure. Such an appliance is termed a *step-down transformer*. When a low pressure current is changed into a high pressure current, the device is termed a *step-up transformer*. It is thus evident that $C_1 E_1$ units of electrical power at a pressure $E_1$ may be transformed into an equivalent amount of electrical power $C_2 E_2$ at another pressure $E_2$. With an ideal transformer

$$C_1 E_1 = C_2 E_2$$

but in practice, however, some losses occur in the process of conversion, and in magnitude $C_2 E_2$ varies from 95 to 97 per cent. of $C_1 E_1$ when working at full load.

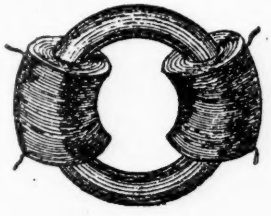


Fig. 1.

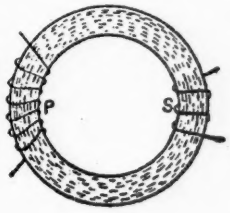



Fig. 2.

A transformer, then may be defined as a device which operates so as to produce instantaneously and directly an increase or decrease of current strength at an expense of a change in the voltage. In many respects a transformer is analogous to the hydraulic press, and is an appliance which does for electrical energy what a system of levers and pulleys does for mechanical energy.

In its simplest form a transformer takes the shape of an annular ring of soft iron wire, upon which the primary and secondary coils are wound. For the purpose of explaining the action of a transformer, we shall consider Faraday's first induction coil, which consisted of a solid iron ring, $\frac{7}{8}$″ thick and 6″ in external diameter, hav-

ing a primary circuit of wire 72 ft. in length, $\frac{1}{20}''$ in diameter, and a secondary circuit of wire 60 ft. in length, coiled around the iron core at opposite parts as shown in Figs. 1 and 2, in which P. represents the primary circuit, and S the secondary. The primary circuit was formed of three superposed helices. In each case the wire was bare, each wire being insulated from the next by twine, while the layers were insulated from each other and the core by layers of calico. The three coils on the primary could be used separately or conjointly, in series or in parallel. The dotted circles in Fig. 2 represent the lines of magnetic force or magnetic flux which are set up when a current circulates through P. In Faraday's experiments the current through P was made intermittent, with the result that transient induced currents were produced in S. In practice only alternating currents are used in the primary circuit, and alternating currents are produced in the secondary circuit. Thus, if an alternating current, having a frequency of *f* periods per second, traverses the primary coil P of our primitive transformer (Figs. 1 and 2), it is obvious that an alternating magnetic flux is developed in the iron core, with the result that a periodic magnetic flux pulsates n opposite directions through the circuit S. This threading or linking of S with an alternating magnetic flux fills and empties the secondary coils at rapid rate, and, according to the laws of electro-magnetic induction, it is clear that an alternating electromotive force, having the same frequency as the primary current supplied, will be induced in S. Furthermore, if the ends of the secondary coil be connected by lamps or wire, an alternating current will traverse this circuit. We thus see that part of the electrical power expended in the primary circuit is recovered in the secondary circuit, and the sources of loss, as we shall presently show, account for the remaining 4 or 5 per cent. of the power expended. As is well known, the inductive action upon which transformers depend exists only while the primary current varies.

At this point it is important to notice that the function of the iron is twofold. (1) It augments the number of lines of force due to the primary current; and (2) it plays the part of a carrier, or forms a suitable medium for the magnetic flux. Consequently, the same result would be produced without the iron core, by placing the secondary coil relatively to P, so that the flux due to the primary current in P, assuming it to be of the same magnitude as when the iron is present, threads itself, and links itself with the coils forming the secondary circuit. It is therefore evident that the E. M. F. is induced in the secondary depends upon, and is a measure of, the *mutual induction* between the two circuits P and S. In many respects the production of this secondary E. M. F. may be compared to the production of the E. M. F. in the armature of dynamo, although there is no revolving mechanism or moving parts in a transformer. It is also an advantage that transformers need no commutator. The action of the primary circuit is identical with the field coil of a dynamo, whilst the secondary circuit corresponds to the armature coils. In each case relative movement between a magnetic flux and a coil of wire yields induced E. M. F.'s, which in both instances are proportional to the number of turns of wire forming the secondary circuit. In the case of the transformer the nature of the current in the primary circuit P produces the variation in the number of leakages of the lines of force with the secondary circuit S.

*English Mechanic.*

---

An Italian has invented a saturation hygrometer which may be used for determining the tension of aqueous vapor in the air in small spaces, such as instrument cases; a portion of the air to be examined is withdrawn and satured with aqueous vapor, and the increase in pressure thus caused is noted. Knowing the saturation vapor pressure, it is possible to deduce the aqueous vapor of the experimental air. The apparatus consists of a bronze receiver fitted with a thermometer; into the receiver passes a glass tube drawn out at the lower end, and connected at the upper end with a syringe which serves to force in drops of water. The receiver may be put in communication with the exterior air, and carries at the side a graduated tube of 3.2mm. diameter, containing a column of petroleum 2.5cm. long.

---

The turning lathe is the best premium ever offered in this country.

# THE GRINDSTONE AND ITS USE.

OLCOTT HASKELL.

Sloyd Instructor, Hitchcock Military Academy, San Rafael, California.

The dirt and inaccuracy usually accompanying work at the grindstone are certainly not attractive features, and it is the object of the writer to suggest ways in which these objections may be lessened and the work made more agreeable. Assuming that we have an ordinary foot-power grindstone some 18″ in diameter x 2 ½″ thick, mounted after the customary manner in an open wooden frame, it should be clamped securely to the axle with the bearings true and in good order that all parts may run easily.

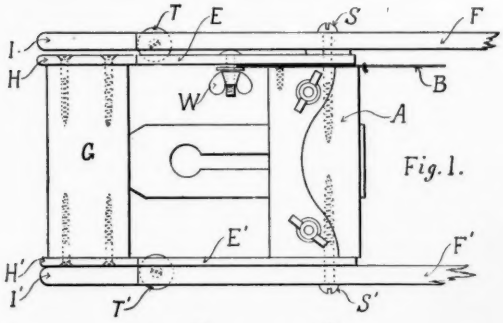



Fig. 1.

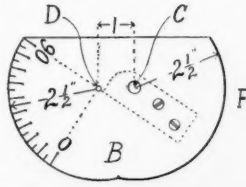



Fig. 2.

An important point to consider is the water supply, since it is necessary during grinding to have the stone thoroughly wet to keep the tool from heating, and also to wash away the dust and waste particles of steel, thus keeping the surface of the stone in good cutting condition. If the lower portion of the stone is run through water (as is frequently done) it will pick up more water than is necessary, the excess splashing and dripping, also when the stone is left standing the part in contact with the water is softened, causing the stone to wear more on that side and become eccentric. Hence the most satisfactory arrangement is to have a small drip-can above the stone, and a trough or pan beneath to catch the waste water.

For a drip-can secure an open tin about 4″ in diameter x 4″ deep and near one edge drive a centre punch from the inside through the bottom. Melt a drop of solder to the jagged edges of this hole and work the punch through the hole until the edges are quite smooth and even. A piece of wood pointed to fit loosely in this hole makes an excellent drip faucet. Prepare a holder for this can by fitting a 3-4″ dowel into a hole bored in the frame at the back of the grindstone, slitting the top of the dowel with a saw to receive the ends of a wide band of heavy tin, which band should be bent loosely around the can and nailed securely in the saw slit. A piece of wood 1-2″ x 4″ x 7″ nailed to the front of the dowel prevents the can from falling through the holder, and also arrests drops from the stone. By revolving the can the water may be made to fall on whatever part of the stone it is most needed.

To catch the waste water secure a sheet of rather thin zinc 13″ wide, x 36″ long and bend up the

sides to form a square trough 36″ long, x 6″ wide x 3 1-2″ deep. Then at one third of the length from either end crimp and fold in the edges, so as to cause the end portions of the trough to stand up at an angle of about 60° with the base. This folding must be done carefully and edges of the folds should be left somewhat rounded, as hammering the zinc flat might

break it, causing leaks that would have to be stopped with solder or melted paraffin. Bore or punch a ½″ hole in the centre of the trough, and by working around carefully from the inside with tapering instruments, such as the rounding handles of a small pair of pliers, burnish and spread the edges until the hole is about ¾″ in diameter. This action should form a smooth rounded lip to the hole so that it may be securely plugged with a rubber stopper. The grindstone must now be removed from its frame and the completed trough nailed in. Such a trough is easily made, and having no joints it cannot leak. In practice it will seldom need emptying, as the water usually evaporates between the periods of grinding. A shallow hopper-shaped frame may be secured around the sides of the stone to catch stray drops, and lead them where they shall fall into the zinc trough.

The grindstone will now be in a much more usable condition than at first, but still our best efforts at grinding will be merely guess work so far as accurate angles are concerned. The following grinding frame is designed to enable us to grind accurately to any desired angle. The accompanying photographs give excellent general views of this frame together with the other fittings, and Fig. 1 gives a top view of the upper end of the frame, while Fig. 2 shows a protractor for measuring the angles.

The grinding frame is formed of the two maple strips *F F′* 1-2″ x 1 1-2″ x ⅝″ which have their lower ends secured to a block of oak or maple 1 1-2″ x 6″ x 13″, and terminate in handles which are joined by having the inner tool frame *A-E-E′* pivoted between them on the screws *S-S*. The entire frame is hinged to the rear of the grindstone support, and is weighted at its lower end, so that when not in use it swings into a vertical position. A firm T hinge should be used and it should be fastened by a single screw to the under side of the block on the grinding frame so that this frame may have motion from right to left as well as up and down.

Referring to Fig. 1, *A*, is a piece of maple 1″ x 2 ½″ x 5 ¼″ beveled off along its front edge so that the edge of the tool, which should extend 3-16″ out beyond the block, may be readily seen. Tools are secured to the under side of this block by a strip of 5-16″ x 1 ½″ x 5″ maple clamped by the two 1-4″ x 2 1-4″ carriage bolts fitted with thumb nuts as shown. To one end of *A* is firmly screwed the protractor *B*, shown more clearly in Fig. 2, where the dotted lines indicate the position of the end of *A* when secured in place. This protractor may be made of heavy sheet brass or of galvanized iron and should have its outline formed by arcs of circles described from the centres *C* and *D* respectively as shown. *C* is a 1-4″ hole drilled to receive the round headed screw *S*. *D* is a small hole just large enough to admit one end of a short length of flexible twine which is secured in the hole by a knot at the back. *D* is in line with the prolonged edge of the tool to be ground and so mark the centre of the circle on which the degrees may be marked. *G* is a block of the same length as *A* and having the two side pieces *E-E′* of 1-4″ x 1 1-2″ x 9″ maple securely fastened to it by several long screws.

It will be seen when the screws *S-S′* are passed loosely through the arms *F-E* and *F′-E′* respectively and screwed into the block *A*, that this block, carrying the tool and the protractor, will turn freely within the frame *E-E′-G*, and that this inner frame is also free to turn between the arms *F-F′* until its moton is arrested by the stops *T-T′* which are formed of the two large iron washers screwed to the under sides of *F-F′*. A short carriage bolt *W*, is fitted with a washer and thumb nut, sewing to clamp the protractor together (with the block *A*, carrying the tool) securely at any desired angle with reference to the inner frame.

The several parts being put together as described, the method of grinding a tool is as follows: Clamp the tool in place with its edge extending 3-16″ beyond the edge of the block *A*; turn the inner frame so that its handles *H-H′* come down in place against the stops *T-T′* of the outer frame; then rest the tool upon the face of the stone and stretch the string from *D* down to touch the middle of the grindstone axle; move the protractor until the string falls across the desired number of degree divisions, and clamp securely in this position by means of the thumb nut *W*. The frame may now be pressed firmly down and the tool ground. To ascertain whether the grinding has progressed sufficiently, it is only necessary to slightly lift the grinding frame and revolve the inner frame until the newly ground fare of the tool comes upper-

most. This rest not only grinds accurately to any given angle, but enables one to give a slightly hollow face to the tail, thus greatly facilitating the whetting.

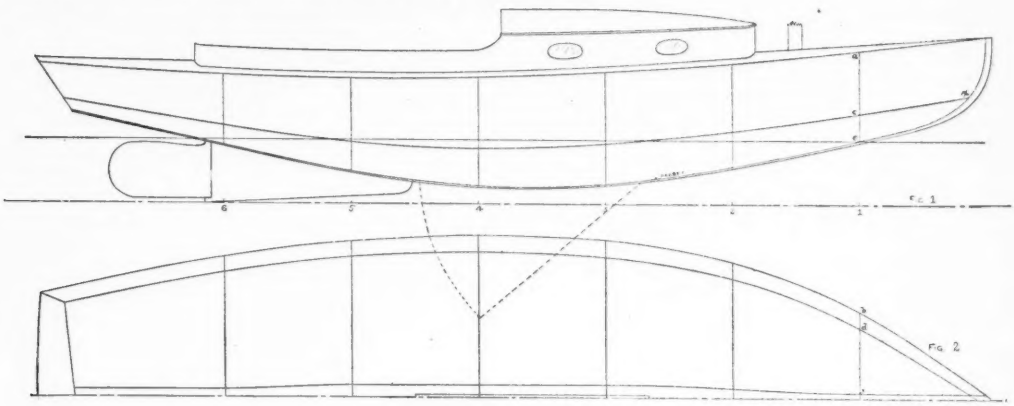
Should the grindstone become uneven, its face may be trued up by holding the end of a short length of iron pipe against the stand, resting the pipe firmly against its framework and rolling it from side to side across the dry face of the stone. When the stone becomes too smooth to cut rapidly, as it frequently may in grinding hard steel, holding the side of the pipe firmly upon the stone during a few turns will clear the surface and put it again in good condition.

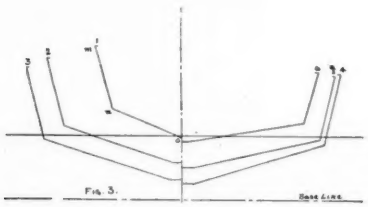
# HOW TO BUILD A SAILBOAT.

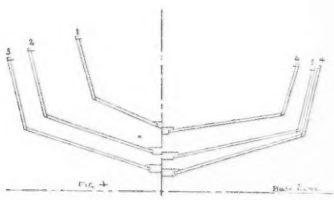
CARL H. CLARK.

## I. Lines and Laying Out.

The type chosen as being the easiest for the amateur to build is that known as the "square sider," as the lines are to a large extent straight with few sharp turns, thus making the easiest possible boat to build. As will be seen from the illustration, the lines of the top sides and of the bottom are all straight, meeting at a more or less sharp corner. While at first sight it might seem as though this corner were a disfigurement, it proves not to be so in the actual boat, the lines being a close approximation to those of a round bottomed boat similiar to the popular "knock about," but as this boat is intended for rough all around weather it was thought advisable to shorten the overhangs to make her easier in a sea way.







The boat as laid out will be found very easy to build, and at the same time very strong, and a good heavy weather boat. While this type is, of course, not quite so fast as an extreme round bottomed boat with long overhangs, it is nevertheless a good sailer and a much better sea boat than she would be with long ends as the latter are apt to pound and throw spray aft.

The boat as laid out is about 16 feet on the waterline and is not so large but that she can be easily built, and yet large enough for two people to sleep aboard comfortable, a small cabin trunk being provided for that purpose.

In starting to build, the first thing is to choose a

suitable place. The best place is one where there is plenty of light and with strong beams overhead. The latter is a very important consideration, as the beams are used to brace against, and it would be almost impossible to do any boat building without them. A wooden floor is also disirable to which braces and blocking may be nailed.

In order to make patterns, or moulds as they are termed, of the several parts, it will be necessary to reproduce a part of the lines full size on a smooth floor. If this is not available a temporary one of boards may be laid, one about four feet wide, and the length of the boat being needed. If desired, in place of this floor a piece of drawing paper may be laid down on any available floor, and removed after the work is done. This will be a good way to preserve the lines for reference.

LAYING DOWN TABLE

| POSITIONS | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| 1. Height of sheer above base line | 3′ 7″ | 3′ 3 1-2″ | 3′ 1″ | 2′ 11 1-2″ | 2′ 11″ | 5′ 0″ |
| 2. Breadth ,, ,, ,, ,, ,, | 2′ 10 1-8″ | 3′ 1 7-8″ | 3′ 7 3-4″ | 3′ 9 1-4″ | 3′ 7 1-2″ | 3′ 3″ |
| 3. Height ,, knuckle above base line | 2′ 1 1-2″ | 1′ 8 1-2″ | 1′ 4 7-8″ | 1′ 3 1-2″ | 1′ 5 1-4″ | 1′ 9 7-8″ |
| 4. Breadth ,, ,, ,, ,, ,, | 1′ 7 1-2″ | 2′ 9 3-8″ | 3′ 3 1-4″ | 3′ 4 1-2″ | 3′ 3 1-4″ | 2′ 10 3-4″ |
| 5. Height ,, rabbet ,, ,, ,, | 1′ 6″ | 10 1-2″ | 5 1-2″ | 5″ | 9″ | 1′ 4 3-8″ |
| 6. Breadth ,, ,, ,, ,, ,, | 1 1-2″ | 2 3-8″ | 3 1-2″ | 3 1-2″ | 3 1-2″ | 2 1-2″ |

| | |
|---|---|
| Height of bow at rabbet | 3′ 11 1-4″ |
| Distance forward of section 1 of rabbet at bow, | 2′ 11 1-2″ |
| Height of sheer at stern | 3′ 3″ |
| Breadth ,, ,, ,, ,, | 2′ 4 3-4″ |
| Height of knuckle at stern | 2′ 5″ |
| Breadth ,, ,, ,, ,, | 2′ 2″ |
| Height of rabbet ,, ,, | 3′ 1 3-4″ |
| Breadth ,, ,, ,, ,, | 2 1-2″ |
| The point $x$ above base line is | 2′ 6 1-4″ |
| ,, ,, ,, forward of section 1, is | 2′ 6 3-4″ |

In order to make a portion of the keel, stem and cross section moulds, it will be desirable, if possible, to lay out the outlines of the sheer plan and the cross sections. The measurements will be found on the drawing. The base line is struck in with a chalk line and the cross sections laid off three feet apart, being sure to make them square with the L. W. L. (Load water line.) The distances are then laid off above or below this line, and fair lines run through them. It may be found that a line exactly through the points would not be fair on account of the unavoidable error in scaling from a small drawing, and laying off again, with a little judgment, a fair line can be struck.

For running curved lines a battern or staff about 1 1-4 in. square and 20 feet long is used, held in place by nails or awls driven alongside of it. When satisfactory lines are secured, they are scratched into the floor with a sharp awl. In the sheer plan the only lines necessary are the deck line, the rabbet, and the top and bottom of the keel. The measurements given are to the rabbet, but the bottom of the keel is 1-2 in. below the rabbet, and the keel is 2 in. thick, so that these lines are easily put in. The cross sections are the only other lines needed, and are laid off as in the drawing; the height of the upper corner being made to agree with the sheer already laid out.

The accompaning table gives the required data for laying out this mould and also those for the moulds for the cross sections and keel. Line 1 gives the height of the top of each section above the base line, which is 18″ below the waterline. Line 2 gives the breadths of the corresponding points from the centre-line. Line 3 gives the height of the before mentioned knuckle, or line of jointure of the two straight lines composing each section and line 4 shows the half breadths of the same points. Line 4 and 5 gives the height and half breadths of the rabbet, or the line where the outer surface of the plank joins the keel.

The sheer plan and the half breath should be laid out as shown in Fig. 1 and 2, these are laid out from the table above, and the outlines made fair. The only lines required are the sheer, the knuckle line and the rabbet line, the dimensions of the overhangs are shown additionally in Fig. 1. The cross sections, shown in Fig. 3 are obtained by coupling the other two plans, for instance, on section 1 the height and half breath of the sheer point are shown at $a$ and $b$ which height and half breadth are used to locate the point in Fig. 3. The points $c$ and $d$ show the height and half breadth of the knuckle on the same frame, which dimensions are used to locate the point $n$ in Fig. 3. In the same way the point $o$ is located from $e$ and $f$. The three points $m$, $n$, $o$ thus gotten are connected by straight line to complete the outline of the frame.

The frames are all to be drawn in the same manner, and used later as patterns to which to fit the moulds or forms upon which the boat is built. The line of the keel is drawn in 1-2 inch below the rabbet, and the line of the top of the keel so drawn as to make the keel 2″ thick. The lines as laid out so far are drawn to the outside of the plank, whereas the moulds which are to be made and used to set up the boat must be made to fit the inside of the plank, as the latter are to be bent around them. It will thus be necessary to draw inside of each cross section or mould already drawn, another one smaller by the thickness of the plank and deck as shown in Fig. 4. This thickness is 3-4″ and the new section is formed by drawing the new lines inside the old ones at a distance of 3-4″. It is also desirable to lay in the keel for convenience in trimming the moulds to fit over the keel when set up.

The bottom of the keel is 1-2″ below the rabbet and the keel is 2″ thick. The top side of the keel projects over on to the plank 1-2″ to form a back rabbet and give fastening for the plank. The widths across the top also give the widths of the keel at each point, which makes it easy to lay off the keel outline.

The laying off on the floor may seem rather tedious but it is the easiest in the end, and also makes a pattern upon which the several parts may be laid to test their fairness. It will be well to take considerable pains with this part of the work, in order that the boat may come fair when set up, and thus save all paring and filling out.

The sternboard, as shown in Fig. 5, is also laid out. Following the lines laid on the floor, a wooden pattern is to be made out of stock about 1-2″ thick to fit the line of the bottom of the keel. It should run the whole length of the keel and stem, and at the forward end should follow the forward side of stem, and at the stern a piece should be fastened on showing the angle of the sternboard. The positions of the cross sections are marked on this mould and also the position of the centreboard slot. It must be so braced that it can be carried about without springing out of shape. This mould is very important as it fixes the shape of the boat and must be accurately laid out.

So much depends upon the shape of the keel, that hits must be correct. The best way to assume this will be to build a solid foundation. A 2″ spruce plank about 10″ wide is set up on edges about 15″ from the floor, and strongiy braced in position. Then using the mould just made as a pattern, the plank is cut to fit it and the ends built up with other pieces of plank and the whole trimmed out until the mould rests evenly on it from stern to the round of the bow. It is then braced sidewise and endwise to be able to stand considerable pressure. This gives a solid foundation to bend the keel into and prevents its changing shape during building.

The same shape could of course, be built up of blocks fastened one on top of another, and securely braced, the tops being beveled off to fit the moulds this is, however not as good as a solid foundation and the former method as much to be preferred.

# HAND SAWS,

## THEIR CONSTRUCTION AND USE.

EXTRACTS FROM "HANDBOOK FOR LUMBERMEN," HENRY DISSTON & SONS.

Fig. 13 is a representation of some of the saws we have seen; there are entirely too many such now in use, and we have no doubt their owners are shortening their lives in the use of them as well as those of the saws. To owners of such saws we say, take them to the factory and have them retoothed, or buy a new saw and take a fresh start, and steer clear of this style of filing.

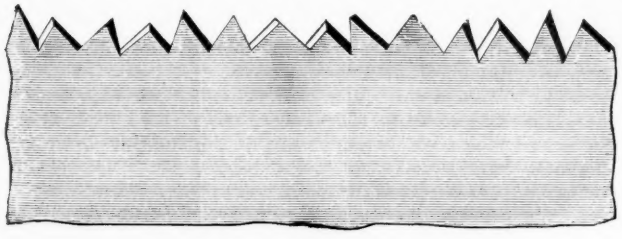


FIG. 13.

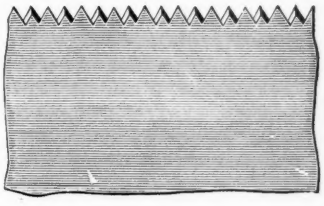


FIG. 14.

As we said in the preceding pages, and as will be seen by Figs. 10, 11 and 12, the filing should be done from the heel of saw toward the point. Many practical saw filers contend this is wrong, that the filing should be done from point of saw toward the handle, but the only support they have for their theory is that they do away with the feather edge that the filing from the heel of saw puts on the cutting face of tooth. The feather edge is no objection, as the main part of it is removed when the teeth are side-dressed after filing, as we direct in our summary of saw filing on Against the correctness of filing from point to handle may be cited the following objections:—

Where a different angle of back is required (it being remembered that angle of face should be the same in nearly all cross-cut hand saws, and that angle of back governs angle of point), it will be found very difficult to obtain it without changing angle of face of tooth,

and as the cutting duty is on the long side of face, any change is of course of great influence. Again, (though we think the above argument sufficient) to file from point of saw, it is necessary to file with the teeth bent towards the operator; this will cause the saw to vibrate or chatter, which not only renders good, clean, even filing impossible, but breaks the teeth off the file.

ner on the back in proportion to its width. These of course, are made for cross-cutting only, as there is not as great a variety in the work, nor as much difference in the woods to be sawed as to degrees of hardness, being used only as a pruning saw on fruit and shade trees, which are always practically green and comparatively soft.

The "nib" near the end of a hand saw has no

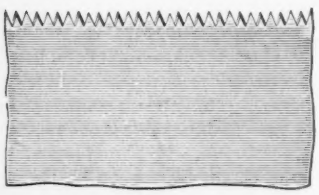


FIG. 15.

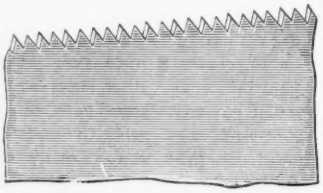


FIG. 16.

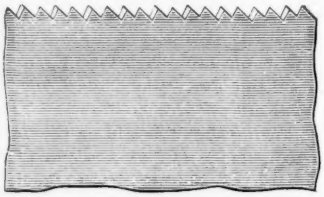


FIG. 17.

In the preceding illustrations, we have only given the coarser saws that are in most general use, but the same principle of filing should be applied to the finer toothed saws regarding angles and pitch suitable for woods of different degrees of hardness, the only actual difference being that one saw has finer points, and they being finer, require a little more care and delicate touch in setting and filing.

Fig. 13 is a section of an eleven-point saw suitable for the finer kinds of work on dry, soft woods, such as cutting mitres, dove-tailing, pattern work etc.

Fig. 15 shows a section of saw with same number of points of Fig. 14, but filed same as Fig. 12. This saw is for finer work, same as Fig. 14 only on the medium hard woods. Fig. 16 is a still finer saw for fine work on the very hardest woods having same dress as Fig. 14.

practical use whatever, it merely serves to break the straight line of the back of blade and is an ornamentation only.

### COMPASS SAWS.

These saws are for miscellaneous sawing. The best form of tooth for this purpose is the same as Fig. 18, excepting that it has a trifle less bevel. As the nature of the work partakes about as much of cross-cutting as of ripping, and as a cross-cut saw will rip better than a rip will cross-cut, it is apparent the shape of tooth should be between the two. These saws are all ground, filed and set in the same manner. Scroll and web saws are ground, filed and set in the same manner, and should have pitch according to the work to be done. If more ripping than cross-cutting is done

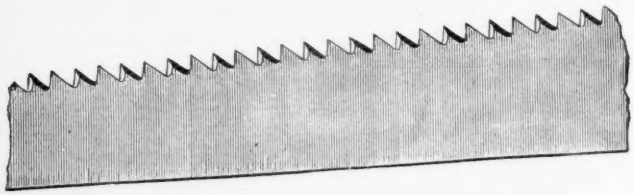


FIG. 18.

FIG. 19.

Fig. 17 is the finest tooth saw of its kind that is made for wood. All the above mentioned saws in Figs. 14, 15, 16 and 17, are made especially hard and will not admit of setting, but being made thinner at the back, when properly filed, will cut clean and sweet. Teeth such as shown in Fig. 17 are used principally on back saws and smooth cutting hand-saws. To maintain the original shape of these teeth use a cant safe back file.

Fig. 18 is a section of a pruning saw which differs from a cross-cut hand saw in being thicker, having a little more pitch to the teeth and being ground thin-

as in large felloes, more pitch is given than in compass saws and *vice versa*, though these saws are almost universally run with a rip-saw tooth and have very little variation in the pitch.

### HACK SAWS.

These saws are for cutting metal, such as brass, iron or untempered steel, and should have a little finer tooth than the average butcher saw. They are so hard that none but the best superfine files will sharpen them. Like the butcher saws, filing must be done straight through and no bevel.

SETTING SAWS.

This is an important part of the work of keeping in order and should always be done *after* the teeth are *jointed* and before filing. In all cases the set should be perfectly uniform, as the good working of the saw depends as much on this as on the filing. Whether the saw is fine or coarse, the depth of set should not go, at the most, lower than half the length of the tooth, as it is certain to spring the body of saw if not break the tooth out. Soft, wet woods require more set as well as coarser teeth than dry, hard woods. For fine work on dry woods, either hard or soft, it is best to have a saw that is ground so thin on the back that it requires no set; such saws are made hard and will not stand setting, and an attempt to do so would surely break the teeth out.

# GAS ENGINE SPARK COILS.

ALBERT GRAHAM.

## II. Coil for "Jump Spark" Ignition.

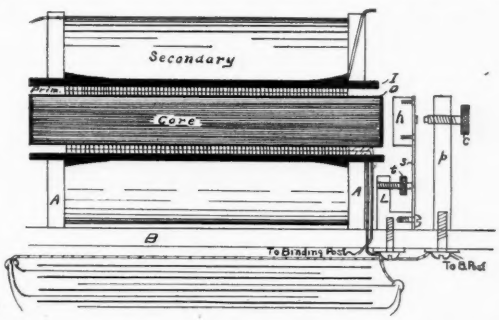
A "fat" spark is desired to insure regular ignition, and to avoid "misfiring," a trouble frequently met in the operation of gas engines, but which may be almost entirely avoided if care be taken to see that all parts are in good working order, and correctly adjusted. For engines of comparatively small size, the length of spark which can be produced from a coil is not so important as that the spark shall be full or strong enough to affect ignition with regularity. The coil here described, if carefully made, will be found adequate for this purpose. It is about the size rated as a half-inch spark coil. A vibrator is shown, but can be dispensed with under certain conditions.

The dimensions of the several parts are as follows:

| | |
|---|---|
| Length of core | 5 inches |
| Diameter of core | 5-8 ,, |
| Guage of core wire | 20 Guage |
| Primary coil, two layers | No. 16, C. C. M. W. |
| Secondary coil, 1 pound | ,, 34, C. C. M. W. |
| Condenser, 40 sheets foil, | 4 x 5 inches |
| Condenser, 60 ,, paper, | 6 x 8 inches |

To make the core, cut into 5″ lengths, enough soft iron wire, 20 guage to make a round bundle ⅝″ diameter; about 150 pieces being the required number. It is quite necessary that they be very soft. If doubt exists on this point, wrap some binding wire around the bundle and put in the fire, allowing it to remain over night, taking it out in the morning when a new fire is made. Then clean and rebind and after dipping the ends in solder so as to secure a solid end, remove the binding wire, file the ends smooth, and soak in paraffin. This may be kept fluid if a hot water bath is used. Do not heat on the fire in a single vessel, as it may possibly ignite when so heated.

Procure or make a round paper tube, 5-8″ inside diameter 5″ long and about 1-16″ thick, mailing tube of the right size will answer. Coat well with spirits shellac and then insert the wire core; the ends of the latter should project about 1-16″ or the hammer end. The primary coil is then wound in two layers upon the inside of this tube, No. 16 single cotton covered magnet wire being used. Leave about 6″ of wire free at the ends for connections. This coil is 4″ long. Coat each layer with spirit shellac, which makes a good insulation. The outside diameter of this coil will be about ¾″. A piece of thick hard rubber or fibre tubing 1 ¾″ inside diameter is then placed over the primary coil. To the ends of this tubing fit square ends *A* of hard rubber or wood ¼″ thick. If wood is used give it several coatings of spirit shellac, paying particular attention to the joint between the ends and the tube. The ends should be 4″ apart, inside




measurements. From the top side of one end drill a 1-16″ hole which will just open at the lower inner side close to the tube. The end of the wire for the secondary coil is put through this hole from the inside, with a short length projecting for connections. Before doing this, however, increase the thickness of the tube at the ends about 1-8″ with several layers of thin bond paper, coating each and binding same with shellac. Be sure to keep the opening clear to the hole in the end for the secondary wire.

The secondary coil can then be wound, after testing the wire with a galvonometer to ascertain that there are no breaks. In winding also, constantly examine the wire, to locate poorly insulated, bent or broken

places which would cause trouble and perhaps spoil the action of the coil. As each layer of the secondary is wound, baste well with paraffin applied with a small, flat brush. Before winding the final layer, put on a single thickness of thin, smooth bond writing paper, and then wind the final layer, the paper giving a smooth, even finish to it. The end of the wire is put through a hole drilled in the other end piece, leaving end for for connections.

The vibrator, if one is used, is made as follows: — The hammer head *h* is cut with a hack saw from a piece of round annealed bar iron, and is $\frac{3}{8}''$ diameter and $\frac{1}{4}''$ thick. It is finished smooth on the faces with a file, then fastened with two minute screws to the piece of spring brass *s*, which is $1\frac{3}{4}''$ long, $\frac{1}{4}''$ wide and about No. 26 guage. The other end of the spring is fastened by a machine screw to the foot *L*, cut out of a piece of bar brass. This is 1-2″ on the base, $\frac{3}{4}''$ high and $\frac{1}{2}''$ wide. A hole is tapped in the base for the screw holding it to the stand, and also for the tension regulator *t*. This regulator is made by drilling the end of a knurled head, machine screw and forcing in a piece of brass wire. The post *p* is a piece of round, brass rod $\frac{1}{4}''$ diameter and $1\frac{3}{4}''$ long. The lower end is tapped for a screw to hold it to the base, a washer being placed under the head of the screw, and at the top and directly in line with the centre of the hammer for the contact screw *C*. This screw shouid have a knurled head, and the point tipped with a bit of platinum. The point of contact at the back of the hammer should also have a piece of platinum soldered to it. To solder on the platinum heat the part, place a drop of melted solder and allow it to cool enongh to see if the solder holds, then warm with blow pipe until fluid and place the piece of plat inum in it and cool. The vibrator should be so located and adjusted that the hammer will, when the coil is in operation, vibrate so rapidly as to make a distinct buzzing.

The condenser is made as follows: — Forty sheets of thin tin foil are cut 4″ x 5″. Sixty sheets of thin wax paper are cut 6″ x 7″. Lay a piece of smooth writing paper on a smooth surface, lay on a piece of the wax paper, then a piece of the foil, with the end overlaping the paper $\frac{1}{2}''$, then another piece of wax paper. Another piece of the foil is then laid on but this time overlaping on the left end. Follow with alternate layers of paper and foil, the ends of the latter projecting alternately on either end, until all the sheets of foil have been used. Examine the paper carefully, rejecting any sheets with holes. If suitable wax paper cannot be purchased, soak thin bond writing paper in paraffin, and smooth with a warm flat iron, interposing a sheet of ordinary paper between the iron and wax paper. Every few layers press with a flat-iron.

The overlaping ends of foil are soldered together with soft solder as follows: — First bring all the ends together with a slight turn, which may be done by pressing them over a small round rod about $\frac{1}{4}''$ diameter. Trim all the ends even and fasten together at two or three places by punching a hole and binding with a fine copper wire. Make a V shaped trough from a strip of sheet iron, closing the ends with putty. Fill this trough to the depth of about 3-16″ with the molden solder, and put one end of the condenser into it and and let harden. It must not be too hot otherwise the foil will melt away from the sheets. If well done, all the sheets will be connected with the solder, to which attach the connecting wires with a drop of solder.

As previously mentioned, a vibrator is not used by some gas engine builders, one fat spark being preferred, if the timing can be accurately adjusted, to the less strong, but more numerous sparks caused by the vibrator. The writer has had no personal experience with a coil without a virbator, so cannot say how satisfactory a working can thus be obtained. Perhaps some of the readers of this magazine can give information on this point.

# PRINTING FOR BEGINNERS.

Frederick A. Draper.

## III. Cases, Stands and Other Furnishings.

To separate words and characters, spaces of varying width are used, the thinner ones being termed spaces and the thicker, quods, shortened from quadrates. In shape they resemble the type, but are shorter and thus make no impression on the paper. The spaces are fractional parts of the em quod; hair line, eight to the em; thin, five to em; middle, four to em; thick, three to em. In addition is the en quod, one half the thickness of the em quod.

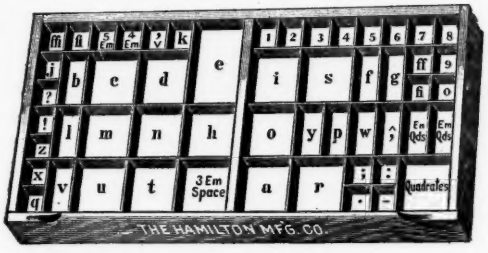
Spaces and quods are not included in fonts of type, but must be ordered separately, one pound to the font being the minimum quantity for satisfactory work, and double this amount or more will often be required. They can be purchased in fonts containing an assortment of each size of spaces and quads, or any one size may also be ordered in quantity as desired.

Additional very thin spaces cast in copper, one-half and one point in thickness, are much used in justifying

lines in advertisements, and also for separating letters in a line to make it more extended. The thick space is the one most commonly used for separating words, and nearly one-third the amount purchased should be of this size. The em quad is used to separate each sentence in a paragraph, also to indent the beginning of a paragraph, and the wider quads to fill out a line not fully occupied by type.

Type, for convenience in handling, is laid in cases which are manufactured in numerous sizes and arrangements of pockets. Body type, or type of which any considerable quantity is required, is laid in a pair of "News" cases; the "Upper case" containing the large and small capital letters, brackets, dashes and less used characters; and "Lower case" containing

CAP OR UPPER CASE.



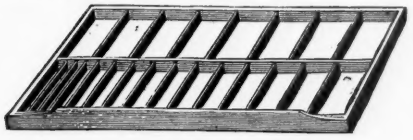

LOWER CASE.

the small letters, figures, spaces and quads, punctuation marks, and a few characters. The places occupied by these cases on a "Stand" is indicated by their names, the upper case being at the back, and the lower case in front.

Unless room is greatly restricted or the type outfit an extremely limited one, type should be laid in full size cases. "Two third" cases are convenient for single fonts, and are suitable for amateurs' use, but preferance should be given to the larger cases. For job fonts containing no small capital letters, the arrangement known as a "California Job" case is the one most generally used. Old cases can be purchased of dealers in second hand materials, but California job cases are so much in demand that new cases will probably have to be purchased. Two third cases can often be found second hand, and a considerable saving is effected when these are obtained, the usual price for second hand cases in good condition being one-third the list price of new cases. A stand can be made for storing cases, one working stand being pur-

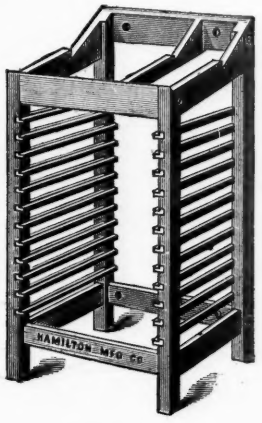
CALIFORNIA JOB CASE.

chased, and here again the second hand dealer can be visited to good advantage. A lead and slug case is also necessary, and is a labor saving devise well worth the small sum required for its purchase. A special



LEAD AND SLUG CASE.

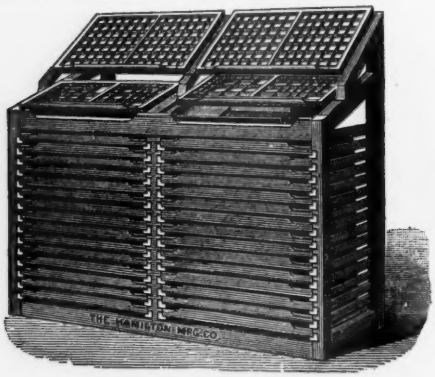
case for fractions is desirable if work is done which requires their use to any considerable extent. Figures for time table and similar tabular work are usually laid in a special case. Type is composed or "set" in




SINGLE STAND.

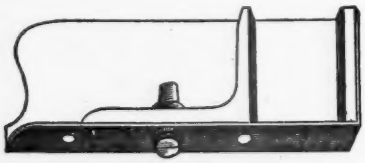
a composing stick, an assortment of sizes being desirable according to the amount and variety of the work. The kind known as a "Screw" stick is the best for regular work in which the measure is not changed. The "Yankee" stick is used for job work and advertisements, as alterations are quickly made.

Reglets are strips of oiled, hard wood about 5-8 of an inch in height, and used for separating lines or sections of type matter, and for filling out the space in the chase preparatory to "locking up" for the

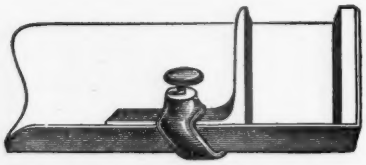



DOUBLE STAND.

press. The commonly used widths are 6, 8, 10, 12, 18, 24, 36, 48, 72 and 144 points, each strip being a yard long. Reglets are of more particular value on odd jobs, where the use of leads would mean the cutting of many pieces not generally usable in other work. The wider pieces are also termed "furniture" and cabinets filled with the more commonly used lengths and widths are to be found in most job offices. The sizes most likely to be of use to the small office are the 6, 12, 24, 48 and 144 point widths, the lengths being cut as required.



SCREW COMPOSING STICK.



YANKEE TOP STICK.

Leads are strips of metal, similar to type metal, of varying thickness and used to place between lines of type to separate them. The stock thicknesses are 1, 2, 4, 6, 10 and 12 points, those 2 points thick being commonly used for single leaded matter. If a lead cutter is included in the outfit of an office, it is best to buy leads in the regular lengths of two feet, and cut it up as needed. It is important that the lengths be multiples of pica ems. As steel measures of the various lengths are expensive, a cheap substitute is to purchase at a type foundry one each of the different lengths of 12 point leads or slugs. As these are machine cut with smooth ends they serve the double purpose of guages for cutting leads and setting the measure of composing sticks. These guage slugs should be handled carefully, and used for no other purposes than those just mentioned.

Furniture is also made of metal, and a suitable stock should form a part of every office equipment. It greatly facilitates the adjustment of cuts, and as it has even and square surfaces, enables a firm "lock up" to be secured where the lines are other than of uniform length. A piece of metal furniture is usually placed at the foot of the standing matter on a galley to keep it in place when handling.

The more generally used materials having been described, we can now consider the handling of them. Upon receiving a font of type from the foundry, the first thing is to lay it in the case. The paper covering is removed by unfolding in such a way that the last turn removed will leave the type face up on the galley with the paper underneath. Slightly moisten the type with a wet sponge, which causes it to cling one to another; otherwise the characters at the ends are quite likely to fall over. Then draw the wrapper from under the type, using care not to upset it. In many offices it is customary to take a proof of the font before throwing in, to ascertain if all the characters are included. Also, if the font is to be added to others of the same kind already on hand, examine the nicks and shoulders of the lower case "m" and cap. "H" to see if the new font is identical with the old. When ordering type, about which any uncertainity exists as to kind or face, it is customary to send to the foundry as samples the two letters above mentioned.

An inspection of the font having shown it to be correct, it is then placed in the case, the compartments for the several characters, if a job font, being located as shown in the illustration. While at first, the peculiar arrangement may seem confusing. A little experience will show that the main purpose is to save labor by reducing the distance the hand moves in securing the type. It will be noted that the cap V is located between the T and W, the V being underneath the T. In some offices this arrangement of the two letters is reversed, and the writer has a preferance for the latter way.

Probably the easiest way to "learn the case" is to place the lettered diagram in a position where it may be easily seen, and begin setting type by its aid. Certain lefters, such as b, d, p, q, will confuse at first. These letters may be known by remembering that type b looks like printed p, and d like q, and visa versa.

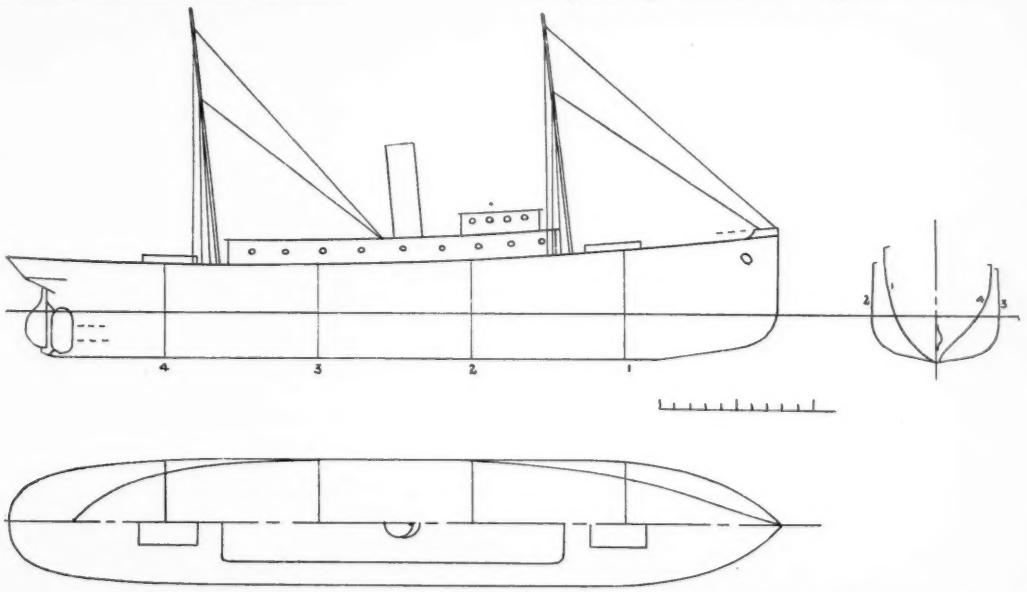
# JUNIOR DEPARTMENT

**For the Instruction and Information of Younger Readers.**

## A MODEL STEAMBOAT

CARL H. CLARK.

The boat illustrated is similar in style and shape to the fast steamers running on the ocean. It is designed to be 50″ long on top, 8″ wide and 6″ deep at the lowest point and should draw about 3″ of water when in trim. She is straight along the bottom to the point where the stem begins to slope upwards; this point is 8″ from the bow. The overhang at the stern from the sternpost is 3″. The length of the stern above the keel is 6 ½″ and that of the bow is 8″.




The shapes of five sections are given 10″ apart, numbers 2 and 3 are alike, 1 and 4 may be scaled from the sketch by using the given scale and a pair of small dividers. The sides amidships should have a slope towards the middle of about ¼″ from the waterline up that is, she should be about ½″ narrower on deck than at the waterline. The waterline forward should be quite sharp and at the stern should be rather more rounded. The best way of getting at just the shape under the stern would be to go and observe some steamer. In this way one could get a far more accurate idea than could possibly be given by any discription.

The method of construction of the hull is the same as that given in the articles on the sailing models, except that it will probably be impossible to obtain a single piece of timber large enough, and several thicknesses will have to be glued together to get the necessary depth. Considerable labor in hollowing out will be saved by sawing a piece out of the centre of each lift before gluing together. The gluing must be very carefully done to stand water, the surfaces of the lifts must be smooth and even and they must be pressed closely together while the glue is drying. The model should not be hollowed out to less than 1″ thick as some wood must be left to give the necessary strength and give surface for the glue to stick to.

The opening for the propeller is about 1 ½″ wide and 3″ high, and should be cut out after the model is finished outside. Along the dotted lines at the stern, a round swelling should be left about ⅜″ in diameter, to allow the shaft to come through. The sternpost is made of a separate piece joined to the rest on the diagonal lines shown. The rudder may be of either wood or metal, about 2″ wide. The small bulwark forward is made of two pieces of thin wood about ⅜″ high and is put on afterwards. The deck should be of about ¼″ stock and should be set in carefully so as to be flush with the upper surface of the hull. It should have a slight forward curve. It will be best not to fasten the deck in firmly until the machinery has been fitted. The deckhouse is about 24″ long, and 5″ wide

and 1 ½″ high, so shaped as to make space between it and the side of the boat even all the way around. This deckhouse may best be a sort of box built up out of thin stock, to be light. The top should extend over about ½″ at the sides and ¼″ on the ends.

The house should be removable and should fit over a little ledge built on the deck. This ledge will hold it in position and keep water out. Some means must be used to fasten it on securely. This allows the examination and adjustment of the machinery, as the deck is cut away under the house. The pilothouse is about 5″ long, 4″ wide and 1 ⅝″ high, fastened on the top of the main house. The masts are ⅝″ diameter at deck, about 18″ long, and are stayed as shown. The foremast extends down to the bottom of the hull, but the mainmast will land on some kind of brace built up over the propeller shaft. The stack is 6″ long and above house 2″ diameter, rolled up out of tin and painted black. It is fastened to the deckhouse and should extend down over the outlet of the boiler, to carry off the heat.

If it is intended to float the model in water it must be very carefully painted inside and outside. The general details, such as rails, hatches, and rigging can best be figured after a visit to some vessel, or a scrutiny of pictures of vessels. There are several other methods of building a model if one is expert enough. A model of this size could easily be planked upon mould in the same manner as a large boat. They are also sometimes made of paper, thin sheet metal, or other material. A railing of wire should be carried around the model, starting from the small bulwark forward as shown by the dotted line.

The house holes are carefully bored and finished. If desired, batches can be made in the deck about 4″ x 4″, and fitted with covers. A great many details may be worked in if desired, small anchors and chains may be made or purchased. A steering gear may be devised, small metal ventilators may be fitted. Derricks may be fitted on the masts, small boats can be placed on the deckhouse, and numerous other additional things will suggest themselves as the work progresses. We have seem models of this size which when well fitted up, were worth considerable money. The description of a steam turbine of proper size for this boat is given in this issue, and a model steam engine is being prepared.

## CORRESPONDENCE.

No. 68. LAKEWOOD, O., Nov. 17, 1903.

I would like to operate a wireless telegraph a distance of about eight miles. Will the apparatus described in the June and July numbers of 1902 be sufficient? If not, what changes should be made?

Please explain the system of wireless telegraphy or telephony using the earth alone as a conductor, and refer me to a book on same.

A. J. H.

Wireless telegraphy instruments capable of transmitting messages over a distance of eight miles would have to be much more elaborate and expensive than those described in the June and July numbers of this magazine. The coil would require to be much larger and giving an eight to ten inch fat spark being necessary. The relay would also have to be of very high resistance, about 1000 ohms. Relative to telegraphy or telephony, by using the earth for transmitting the currents; much more work as has been done in this line has not been very fully described in the technical papers, so that the methods used could be fully determined. Information on this subject will be welcomed for insertion in this column.

No. 69. DORCHESTER, MASS, Nov. 30, 1903.

Please give me a receipt for invisable ink, to be made visible by means of some chemical solution?

C. E. B.

A thin solution of arrowroot, used with a stub pen on rough paper, is developed by placing in steam of a weak solution of iodine in water, heated in a dish upon a stove. It fades again upon drying, but may be revived several times in the same way.

## BOOKS RECEIVED.

TOOLS AND MACHINES. CHARLES BARNARD. 158 pp. Price $1.25, Silver Burdett & Co., Boston, Mass.

As an introduction to the study of tools and machines and their uses, teachers of Sloyd and the first grades of Manual Training will find this a serviceable desk book. The clear and attractive way the subject matter is presented, makes it readily usuable for reading exercises, and for this purpose can be warmly commended. Detail directions for the use of tools are not given, its purpose not being to serve as a manual. 62 Illustrations.

THE TEACHERS HAND BOOK OF SLOYD. OTTO SALOMAN. Translated by Mary R. Walker and William Nelson, Second Edition. 264 pp. Price $1.50 Silver Burdett & Co., Boston, Mass.

The teacher of Sloyd who does not have a copy of this book within easy access should get it at once. Its presentation of the educational ideas upon which this system of instruction is based, are so clear that the attentive reader cannot fail to gain a good perspective of the whole system, as well as a large amount of detail relating to the numerous exercises given. Over 130 illustrations supplement the text.

PRACTICAL LESSONS IN ELECTRICITY. Four parts. Different authors, 254 pp. 70 cents. American School of Correspondence, Chicago, Ill.

The purpose of this volume is to give the public an opportunity to judge of both the standard and scope of the correspondence instruction offered by this school, but contains much practical information making it of value to both the practical electrician and also the amateur. Readers of this magazine interested in electricity will find the book of value, and are cordially recommended to obtain it.

# AMATEUR WORK

We here illustrate the combination set of "Yankee" tools made by North Bros. Mfg. Co., Philadelphia, Pa. This has been but lately introduced to the trade, but the large number being purchased for household use, show that it well meets a large demand.

The C. & T. Electric Co., Syracuse, N. Y. are dealers in a line of electrical goods which should be of much interest to readers of this magazine. A catalogue will be mailed upon request to those enclosing stamp for postage.

The ease with which the ball bearing screw-driver, manufactured by the H. H. Mayhew Co., Shelburne Falls, Mass. will turn a screw in or out is astonishing to one who tries it for the first time. It is a fine tool, which should be included in the kits of both professional and amateur.

The wide variety of high grade wood and metal working tools and machines manufactured by the Senaca Falls Mfg. Co., Senaca Falls, N. Y. are all such as the professionalor amateur will find usable to the largest extent. A new catalog is in preparation, and will be announced in these columns when ready.

The miniature rheostat made by Kendrick & Davis, Lebanon, N. H. is one of the most popular electrical devices this firm has yet placed upon the market, the demand being far greater than was anticapated, though a large number were made. It has 5 ohms resistance and is just the thing for regulating battery currents to motors, etc.

The saw filing guide, manufactured by Henry Disston & Sons, Philadelphia, Pa., enables an inexperience person to do a very creditable job at filing a saw. Manual Training schools should include one of these guides in their equipment, thereby enabling practical instruction in saw filing to be easily given, a subject frequently neglected in many schools.

The models of engines, boilers, dynamos, motors, etc., offered by the Martin Mfg. Co., 180 W. Madison St. Chicago, Ill. should be of much interest to readers of this magazine, especially those attending manual training schools where, out of hours, castings can be machined and finished. The making of a model of this kind has great educational value to young men, and should re ceive greater attention than it frequently does.

The many useful tools to be found in the catalogue of The L. S, Starrett Co. Athol, Mass. which may be obtained at comparative ly small sums, considering their value to the mechanic, leads one to wonder why anyone ever tries to get along without suitable tools. It is doubtful if such workers would be so negligent of their own interests if they had the catalogue before them for examination, and all mechanics without it are recommended to write without further delay.

The machine equipment of the manual training schools does not always receive the consideration, in advance of purchase, which its importance demands. All tools for such use, should be of the latest and most approved design; otherwise, pupils will not receive the information which should be given them upon this subject. To quite an extent, instructors have it within their means to specify the kind, and often the make, when new equipment is to be purchased. For this reason, proper attention should at all times be given to procuring catalogues and other descriptive matter from manufacturers, and keeping the same upon file where reference to them can be easily made by both pupils and committee. Of much importanceto those interested in wood-working, are the tools and machines made by the American Machine Co., Grand Rapids, Mich., who will bepleased to send information to anyone contemplating the purchase of tools in their line.

The Smith & Hemenway Co., have contracted with the Page Storms Drop Forge Co., to handle the entire marketing on their engineer's wrenches and hereafter the Page-Storms Drop Forge Co., New York office will be at 296 Broadway, with the Smith & Hemenway Co., who will look after that end of their business exclusively.

In addition to manufacturing drop forged engineer's wrenches, they make a specialty of making frogings from blue prints or samples, for anyone desiring this class of work. Parties interested or wishing to have forgings made should make their request known direct to the factory at Brightwood, Mass.

A good screw-cutting lathe is the desire of every amateur mechanic, and those possessing them are the object of congratulation from all their friends. Others could be equally fortunate if of the mind to exercise a little economy for a time, and put aside a small sum each week. It would not be long, if this were done, before an excellent lathe could be purchased, and those made by W. H. Young & Co., Worcester, Mass., will be found of first class design and construction. A descriptive catalogue will be sent upon request.

The attention of our readers is called to the India Oilstone, advertised in this issue. Although this oilstone has been on the market for several years, it is, comparatively speaking, of recent origin. The India Oilstone is what is usually termed an artificial stone as distinguished from those stones cut from natural rock. It is made from pure crushed corundum, the hardest of all minerals, the diamond alone excepted, and is therefore, an extremely fast cutting stone of remarkable durability.

It has several points of advantage over other oilstones, principal among which is its evenness of grain. It has no hard and soft spots, thereby presenting an even working surface at all times. It is very strong and will not break under any ordinary conditions. It can be made into any desired shape or size for special tools as it is made in moulds and then vitrified, instead of being cut or sawn. It is of extreme hardness and will cut metals on which the very hardest tempered files will slip.

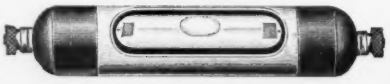
The India Oilstone line is manufactured by the Norton Emery Wheel Co., and marketed by the Pike Mfg. Co., of Pike, N. H., who are its sole selling agents. The latter Company which is doubtless well known to our readers as the largest producer of Sharpening Stones in the world, is this year celebrating the eightieth anniversary of the establishment of its business, this alone being a guarantee that it has accumulated a knowledge regarding sharpening stones of which the would-be purchaser will do well to avail himself.

## SOMETHING ELECTRICAL FOR EVERYBODY.

**The GEM MOTOR**

Finished in Black Enamel, screws and bearings Nickel Plated.
Mounted on a Polished Wood Base.
Net price, each 80 Cents.
By mail, 25 cents extra.

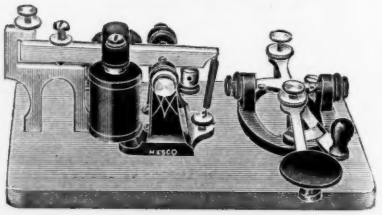
**POLARITY INDICATOR**



Neat, Compact and Reliable. Will indicate positive or negative pole on Battery or Dynamo circuit.
Net price, each 75 Cents. By mail, 5 cents extra

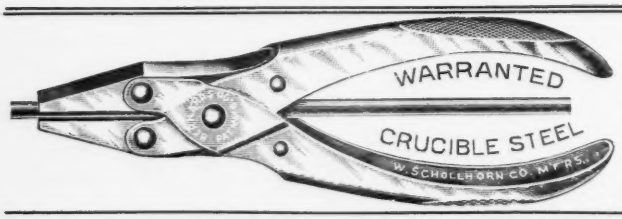
Our Catalogue No. 16, Mailed Free on application. Illustrates and Describes Hundreds of Specialties required by the Amateur and Practical Electrician, and at Prices that will surprise you.

**EUREKA TELEGRAPH SET**



All the working parts are Finely Finished Composition metal, such as used in all high grade instruments. The base is mahogany, and highly polished. The key is of the steel lever pattern. A book of instructions for amateurs is furnished gratis with each instrument.
Net price, wound 5 ohms $1.30: 20 ohms, $1.50
By mail, 40 cents extra.

**MANHATTAN ELECTRICAL SUPPLY CO.,**
**32 Cortlandt St., New York City. 188 Fifth Ave. Chicago, Ill.**




## BERNARD'S PATENT PLIERS, NIPPERS, BELT AND TICKET PUNCHES

Cut shows Open Throat, Parallel Jaw Pliers with VISE GRIP. Constructed on a new principle embodied in BERNARD TOOLS ONLY. Leading Hardware Dealers sell OUR TOOLS. Made by

**THE WM. SCHOLLHORN CO. New Haven, Conn**

Worthy of it's Name

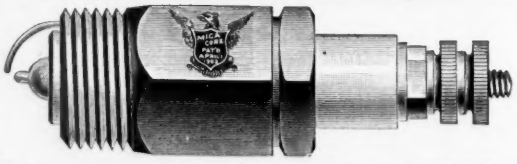
**The "WORKWELL" Telephone**

Absolutely the BEST Telephone ever offered at the the price, $7.50 a pair. Fully Guaranteed

**The "RELIANCE" Transmitter**

The BEST Telephone Transmitter on the market sold at a low price. Can be fitted to any style of box. A Sample sent by mail, prepaid, for $1.00 **Order by Name.**

**S. H. COUCH CO.,**
**154 Pearl St. Boston, Mass.**



Equip your engine with the celebrated **AMERICAN JUMP SPARK IGNITION APPARATUS.** The American Spark Coils, American Indestructible Sparking Plugs, American Little Wonder and American Dry Batteries **LEAD ALL OTHERS.** Write for catalog.

**AMERICAN COIL COMPANY,**
**West Somerville, Mass.**

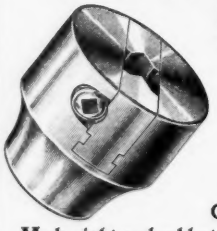
**IF** You want the BEST SCREW PLATES, TAPS, ADJUSTABLE DIES, etc.
Then try those made by

## THE E. F. REECE CO.

**Greenfield, Mass.**

You can get them of your Hardware Dealer
Ask for the "REECE" tools
**Catalog Free**

## No Weak Places In the REID DRILL CHUCK



One part is as strong as another,
Outwears any other kind of chuck.
Made right and sold at the right price. Send for prices.

**R. H. BROWN & CO.,**
**New Haven, Conn.**